98TH CONGRESS } HOUSE OF REPRESENTATIVES { REPORT
1st Session } { No. 98-95

AUTHORIZING APPROPRIATIONS TO THE NATIONAL BUREAU OF STANDARDS FOR FISCAL YEAR 1984

MAY 9, 1983.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. FUQUA, from the Committee on Science and Technology, submitted the following

REPORT

together with

MINORITY AND ADDITIONAL VIEWS

[To accompany H.R. 2513]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science and Technology, to which was referred the bill (H.R. 2513) to authorize appropriations to the Secretary of Commerce for the programs of the National Bureau of Standards for fiscal year 1984, and for other purposes, having considered the same, report favorably thereon with amendments and recommend that the bill as amended do pass.

The amendments are as follows:

Page 2, line 6, strike "$23,371,000" and insert "$22,881,000"

Page 2, line 10, strike "$13,907,000" and insert "$14,356,000"

Page 2, line 13, strike "$10,459,000" and insert "$10,659,000"

Page 3, line 3, strike out "and" after the semicolon; on line 6, strike out the period and insert in lieu thereof "; and", and after such line insert the following:

> (6) of the total amount authorized under subsection (a)(7), not less than $400,000 shall be available for the Central Planning Office.

Page 4, after line 10, insert the following new section (and redesignate the succeeding sections accordingly):

> SEC. 105. In addition to the sums authorized to be appropriated by Section 104, there is authorized to be appropri-

H703-6

ated to the Assistant Secretary of Commerce for Productivity, Technology and Innovation the sum of $175,000 to make Japanese science and engineering literature available in the United States. The National Technical Information Service is authorized to make use of contracts and grants for all or part of this task and a report of the results, with appropriate recommendations, shall be submitted to the President and Congress no later than December 31, 1984.

PURPOSE OF THE BILL

The purpose of the bill is to authorize appropriations for fiscal year 1984 to the National Bureau of Standards and related agencies out of money in the Treasury not otherwise appropriated, as shown in the following table.

	Authorization fiscal year 1984
National Bureau of Standards:	
Measurement research and standards	$52,031,000
Engineering measurements and standards	22,881,000
Computer science and technology	11,500,000
Core research program for innovation and productivity	14,356,000
Technical competence fund	7,672,000
Fire research center	6,386,000
Central technical support	10,659,000
Subtotal, NBS	125,485,000
Excess Foreign Currency, NBS	700,000
National Technical Information Service	175,000
Office of Productivity, Technology, and Innovation	3,752,000
Total, H.R. 2513	130,112,000

CONTENTS

	Page
Purpose of the bill	2
Contents	3
1. Summary of committee action	5
Committee budget actions	5
Budget total	5
Increases in H.R. 2513 for NBS	5
Specifications	5
Comparison with budget requests	6
Other committee actions	6
Organic act amendment	7
Financial provisions	7
2. Committee budget actions	7
National Bureau of Standards	7
Overall NBS budget level	7
Measurement research and standards	8
Engineering measurements and standards	8
Computer science and technology	9
Core research program for innovation and productivity	9
Technical competence fund	9
Center for fire research	10
Central technical support	10
Funding floors	10
1. Center for building research	10
2. Measurement standards for the handicapped	11
3. Computer science and technology	11
4. Robotics research and development	11
5. Center for fire research	11
6. Central planning office	12
Excess foreign currency	12
Office of Productivity, Technology and Innovation	12
National Technical Information Service	13
3. Additional provisions of the bill	13
Cost recovery authority (Sec.103)	13
Salary adjustments (Sec. 106)	13
Availability of appropriations (Sec.107)	13
Transfer of funds (Sec. 108)	13
Activities performed for other agencies (Sec. 109)	13
4. Committee views	14
Center for fire research	14
Center for fire research: toxicity study	14
Center for building research	15
Computer science and technology	15
Scientific computing capability	17
Format of budget book	17
Dissemination of competitive assessments	18
5. Explanation of budget categories	19
National Bureau of Standards	19
1. Measurement Research and Standards	19
2. Engineering Measurements and Standards	28
3. Computer Science and Technology	36
4. Core Research Program for Innovation and Productivity	38
5. Technical Competence Fund	46
6. Center for fire research	48
7. Central Technical Support	49

5. Explanation of budget categories—Continued | Page
  Office of Productivity, Technology and Innovation 54
  National Technical Information Service 58
6. Sectional analysis of the bill 59
7. Oversight activities 61
8. Oversight findings and recommendations by the Committee on Government Operations 61
9. Congressional budget act information 61
10. Cost estimate, Congressional Budget Office 62
11. Cost and budget data 63
12. Effect of legislation on inflation 63
13. Committee recommendation 64
14. Administration views 64
15. Changes in existing law made by the bill as reported 68
16. Minority views 70
17. Additional views 71

1. SUMMARY OF COMMITTEE ACTIONS

COMMITTEE BUDGET ACTIONS

The following Committee actions are reflected in the Bill H.R. 2513.

BUDGET TOTAL

The President's budget for fiscal year 1984 included a request of $98.7 million for the National Bureau of Standards, representing a decrease of $19.2 million from the fiscal year 1983 current appropriation of $117.9 million; $3.7 million for the Office of Productivity, Technology and Innovation, reflecting a reduction of $146,000 from fiscal year 1983; and zero funding for the National Technical Information Service, or a decrease of $1.9 million from fiscal year 1983.

H.R. 2513 would authorize the sum of $125.5 million for the National Bureau of Standards. This is $26.8 million above the President's request and $7.6 million above the fiscal year 1983 appropriation. The Committee bill would authorize $3.8 million for the Office of Productivity, Technology and Innovation, which is identical to the President's request. H.R. 2513 would authorize $175,000 to the Assistant Secretary of Commerce for Productivity, Technology and Innovation for the National Technical Information Service. This is $1.7 million below the fiscal year 1983 appropriation, and $175,000 above the President's request for NTIS.

In addition, the bill would authorize excess foreign currencies for use by the National Bureau of Standards in the amount of $700,000, which is identical to the President's request.

INCREASES IN H.R. 2513 FOR NBS

The bill, as adopted by the Committee, reflects the following increases in the President's budget:

Measurement Research and Standards would be increased by $3.3 million from the NBS request of $48.7 million to $52.0 million.

Engineering Measurements and Standards would be increased by $4.4 million from the NBS request of $18.5 million to $22.9 million.

Computer Science and Technology would be increased by $8.5 million from the NBS request of $3.0 million to $11.5 million.

Core Research Program for Innovation and Productivity would be increased by $1.9 million from the NBS request of $12.4 million to $14.3 million.

Fire Research Center would be increased from the NBS request of zero funding to $6.4 million.

Central Technical Support would be increased by $2.3 million from the NBS request of $8.4 million to $10.7 million.

SPECIFICATIONS

Minimum funding levels are included in the bill for the following programs:

Of the $52.0 million authorized by the bill for Measurement Research and Standards, not less than $500,000 would be available for the program of Measurement Standards for the Handicapped.

Of the $22.9 million authorized by the bill for Engineering Measurements and Standards, not less than $4.5 million would be available for the Center for Building Research, and not less than $500,000 would be available for the program of Measurement Standards for the Handicapped.

Of the $11.5 million authorized by the bill for Computer Science and Technology, not less than $10.5 million would be available for this program.

Of the $14.3 million authorized by the bill for the Core Research Program for Innovation and Productivity, not less than $3.5 million would be available for Robotics Research and Development.

Of the $6.4 million authorized by the bill for the Fire Research Center, not less than $6.4 million would be available for fire research.

Of the $10.7 million authorized by the bill for Central Technical Support, not less than $400,000 shall be available for Central Planning.

COMPARISON WITH BUDGET REQUESTS

Committee actions on the President's budget request for the National Bureau of Standards and related activities are reflected in the table below:

NATIONAL BUREAU OF STANDARDS AND RELATED AGENCIES—FISCAL YEAR 1984 BUDGET HISTORY

[In thousands of dollars]

	Fiscal year 1983 appropriation	Administration fiscal year 1984	Administration changes	Fiscal year 1984 committee bill	Committee bill compared to—	
					Fiscal year 1983 appropriation	Administration budget request
Measurement research and standards	47,516	48,709	1,193	52,031	4,515	3,322
Engineering measurements and standards	21,682	18,507	−3,175	22,881	1,199	4,374
Computer science and technology	10,000	3,000	−7,000	11,500	1,500	8,500
Core research program for innovation and productivity	13,107	12,407	−700	14,356	1,249	1,949
Technical competence fund	6,986	7,672	686	7,672	686	0
Fire research center	5,886	0	−5,886	6,386	500	6,386
Central technical support	12,684	8,405	−4,279	10,659	−2,025	2,254
NBS subtotal	117,861	98,700	−19,161	125,485	7,624	26,785
Excess foreign currency	500	700	200	700	200	0
NTIS	1,880	0	−1,880	175	−1,705	175
OPTI	3,898	3,752	−146	3,752	−146	0
Total	124,139	103,152	−20,987	130,112	5,973	26,960

OTHER COMMITTEE ACTIONS

The following Committee actions which would provide for the use of appropriations made available to the National Bureau of Standards and for other purposes and which would amend the Bureau's Organic Act are also reflected in the bill H.R. 2513.

ORGANIC ACT AMENDMENT

A provision amending the NBS's Organic Act to permit the recovery of the Bureau's operating costs is included as Section 103.

FINANCIAL PROVISIONS

A provision clarifying how a shortage of funds for possible salary increases in fiscal year 1984 is to be dealt with is incorporated as Section 106.

A provision specifying that funds appropriated under this Act shall remain available as specified in the Appropriations Act is incorporated as Section 107.

A provision permitting transfers of funds between program line items is incorporated in the bill as Section 108.

A provision directing the Secretary of Commerce to charge for services mandated by law to be performed by the Bureau or requested by another Agency of the Government is incorporated in the bill as Section 109.

2. COMMITTEE BUDGET ACTIONS

NATIONAL BUREAU OF STANDARDS

The Committee expresses the following views explaining the budget actions for the National Bureau of Standards. It is noted, in connection with the overall level that would be authorized for the Bureau, that, in accordance with the provisions of the NBS Organic Act, extensive research and development activities are conducted on a reimbursable basis for other government agencies. The NBS estimates that in fiscal year 1984 such other agency work will account for an additional approximately $75 million in resources available for these specific tasks.

Overall NBS Budget Level

The National Bureau of Standards (NBS), the Nation's oldest national laboratory and the lead agency for measurement science and standards, was created by the Act of March 3, 1901.

The basic mission of NBS is to apply its expertise in science and engineering specifically in the following areas: the custody, maintenance, and development of the Nation's standards of physical measurement and provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods for testing materials, mechanisms, structures, supplies and equipment; cooperation with other Federal agencies and the private sector in the establishment of standard practices; the provision of advisory services to government agencies on scientific and technical problems; and the invention and development of devices to serve special national needs.

The Committee believes that the National Bureau of Standards plays an important role as the Nation's measurement standards and generic technology development laboratory, and thus is vital to the country's efforts to increase productivity and achieve a higher level of industrial innovation.

The Committee concludes that the severe reductions proposed for the NBS, amounting to a 16 percent cut compared with the fiscal year 1983 budget and including the complete elimination of the Center for Fire Research and the Center for Building Technology, and the 70 percent reduction for the Institute for Computer Sciences and Technology, cannot be justified. Instead, a modest $7.6 million or 6.4 percent increase in the NBS budget is recommended.

MEASUREMENT RESEARCH AND STANDARDS

Measurement research and standards development is performed by NBS's National Measurement Laboratory (NML). The NML continues to perform as a vital organizational unit of the Bureau. It provides a national system of physical and chemical measurement; coordinates that system with measurement systems of other nations; furnishes essential services leading to accurate and uniform physical and chemical measurements throughout the Nation's scientific community, industry, and commerce; conducts materials research leading to improved methods of measurements, standards, and data on the properties of materials needed by industry, commerce, educational institutions, and government; provides advisory and research services to other Government agencies; conducts physical and chemical research; develops, produces, and distributes standard reference materials; provides standard reference data; provides calibration services; and collaborates with the Bureau's other major organizational units in carrying out its responsibilities. The Committee believes that these contributions can only enhance our country's role to improve measurement standards throughout industry and government, and the bill would authorize direct funding of $52.0 million for this subactivity.

ENGINEERING MEASUREMENTS AND STANDARDS

The National Engineering Laboratory (NEL) conducts the engineering measurement and standards activity of the Bureau. The NEL provides technology and technical services to public and private sector entities as they address national needs in areas such as public health and safety, measurement standards for the handicapped, regulatory reform, energy utilization, defense, productivity, and international trade. To support this effort, the NEL conducts research in engineering and applied science, builds and maintains competence in the disciplines required to carry out this research and technical service, develops engineering data and measurement capabilities, provides engineering measurement calibration services, develops test methods, and proposes engineering standards and code changes. The NEL also proposes new engineering practices, improves mechanisms to transfer results of its research to the ultimate users and develops and demonstrates new institutional practices to stimulate the use of technology. The Committee supports the lead role the NEL plays in providing technical services and data which help to boost the Nation's productivity. The bill would authorize $22.9 million in direct funding for the efforts of the National Engineering Laboratory.

COMPUTER SCIENCE AND TECHNOLOGY

The Institute for Computer Sciences and Technology (ICST) conducts the computer science and technology program. Under authority provided to the Secretary of Commerce by Public Law 89-306 (Brooks Act), ICST carries out the following responsibilities to improve the Federal Government's management and use of automatic data processing (ADP): develops Federal ADP standards; provides agencies with scientific and technological advisory services relating to ADP; undertakes necessary research in computer science and technology.

The Committee believes the activities of ICST to develop standards for high level programming languages, software, computer system and network interface, computer security, and data base management are vital to the productivity and cost effectiveness of the Federal Government as well as private sector ADP users and manufacturers. ICST participation in developing international standards is essential to reducing barriers to the flow of information and to trade. The bill includes $11.5 million for work in computer science and technology which would permit support for the development of international standards and research in support of standards development.

CORE RESEARCH PROGRAM FOR INNOVATION AND PRODUCTIVITY

The National Bureau of Standards has unique capabilities to assist in stimulating innovation in industry to sustain economic growth and improve productivity. The bill would authorize $14.4 million for the Core Research Program for Innovation and Productivity which is aimed at the advancement, through research and development, of selected generic technologies.

The Committee's hearings on technological innovation over the past four years have emphasized repeatedly: (1) the direct and significant relationship between R & D investment and technological innovation; (2) the importance of technological innovation in fostering increased productivity, employment opportunities, economic growth, and favorable trade balances; and (3) the national, social and economic importance of technological innovation and enhanced productivity in combatting inflation.

In light of these findings, the Committee reaffirms the value of the Bureau's Core Research Program, which was established two years ago at the request of Congress. The bill would authorize $14.4 million for this program. Research areas, identified by the Committee as being of sufficient national technological importance to merit inclusion in this program, include: (1) Measurement Standards for Advanced Metals Processing; (2) the Semiconductor Program; (3) Automated Manufacturing Interface Standards; (4) Mechanical Engineering Metrology; (5) Robotics Research and Development; and the Automated Manufacturing Research Facility.

TECHNICAL COMPETENCE FUND

In order to insure that the Bureau maintains and improves upon the underlying knowledge and skills necessary to meet the responsibilities delegated to it in the enabling legislation, additional legislative mandates, and administrative directives, research is supported from the Technical Competence Fund. These research projects (most are basic in nature) are of a long-term or theoretical nature. The decision to go ahead with a project is based on the potential that project holds for enhancing the Bureau's expertise in measurement science and technology. With this research base, the Committee believes the Bureau is in a better position to continue to respond effectively to emerging technical needs, and thus, the bill would authorize $7.7 million for this purpose.

CENTER FOR FIRE RESEARCH

The Center for Fire Research was established by the Congress in 1974 by the Fire Prevention and Control Act to conduct research on the prevention and control of fires. The Committee strongly supports the continuation of the Center for Fire Research and has provided funding in the amount of $6.4 million. The funding in the bill represents an increase of $500,000 over fiscal year 1983. The Center for Fire Research also funds an extramural grants program to universities and research institutions in addition to its in-house research program which totalled about $2 million in fiscal year 1983.

CENTRAL TECHNICAL SUPPORT

The bill would authorize $10.7 million for Central Technical Support. Included in this line item are $400,000 for the Central Planning Office, $2.6 million for the Research Associate Program and $1.7 million for Computing Support. Also included are $5.3 million for Transfers to the Working Capital Fund to recover the replacement value of NBS depreciable equipment inventory and to provide for capitalization of Standard Reference Materials research and development costs.

FUNDING FLOORS

The Committee identified a small number of NBS program activities which were judged to be of exceptional importance. For these activities the bill would provide minimum funding levels.

1. CENTER FOR BUILDING RESEARCH

In the area of building research, NBS performs a vital role in providing the technical basis for codes and standards which are the heart of our building system in the United States. In addition, the Center for Building Research provides a basis for NBS to develop significant expertise in the area of building technology and thereby it is able to well serve the needs of the public when expert, third-party investigations are requested following a building failure such as the Kansas City Hyatt Regency walkway collapse. These investigations, besides providing local governments and local officials with a very much needed service, also provide NBS with guidance for research efforts. The bill provides a minimum of $4.5 million for this center.

2. MEASUREMENT STANDARDS FOR THE HANDICAPPED

The bill would make available not less than $1.0 million for Measurement Standards for the Handicapped. The Committee believes that the National Bureau of Standards, through its expertise can make important contributions in this area.

This program can enhance the ability of the handicapped to function in the normal environment and facilitate environmental modifications which reduce barriers faced by the handicapped. The Committee expects the National Bureau of Standards to provide measurement methods and performance standards in building technology and materials science to insure the safe, efficient operation of devices and facilities designed for use by the handicapped. With expertise in materials sciences, building technology, standards activities, and technical information dissemination, the Bureau can play an important role in the development of technological solutions for problems of the handicapped.

3. COMPUTER SCIENCE AND TECHNOLOGY

NBS's Institute for Computer Sciences and Technology (ICST) follows a comprehensive plan for the development of Federal automatic data processing standards and guidelines. The timely development of needed Federal standards is critical to the effective use of this rapidly emerging technology by the Federal government. Furthermore, ICST participation in developing international standards is essential to maintaining a U.S. competitive position in international trade. These important functions are dependent on adequate resources for supportive research and U.S. participation in international meetings. ICST has demonstrated the necessary expertise to make significant contributions in these areas. Therefore, the Committee has included in the bill a $10.5 million minimum for fiscal year 1984 to ensure that these activities will be continued at a high level of quality and in a timely fashion.

4. ROBOTICS RESEARCH AND DEVELOPMENT

Programmable, flexible materials handlers, also known as industrial robots, will play a major role in the factory of the future. Standards for such devices must be developed to assure computer compatibility and interchangeability. This program will include research on intelligent vision systems, the development of hierarhical control strategies, interface standards and other related subjects needed for industrial advances in this field. Many feel that the Japanese are further along than the United States in the introduction of robots into the factories, though not in the technology of the robots themselves. The Committee has included a floor of $3.5 million for research and generic technology development in the field of robotics.

5. CENTER FOR FIRE RESEARCH

The Center for Fire Research performs unique and much needed fundamental work on fire research including: predictive capability development, mathematical models of fire growth and spread, soot formation and thermal degradation processes. Test methods and proposals for voluntary standards and codes are also developed. The Committee has included a floor of $6.4 million, for the Center for Fire Research.

6. CENTRAL PLANNING OFFICE

The Committee, aware of the steadily growing importance to the nation of science and technology and of those agencies of the Federal Government with principal missions in the field of science and technology, has urged the close attention by those agencies to the matter of strategic or long-term planning. In the case of the National Bureau of Standards, the Committee, in its legislative report on the the fiscal year 1983 authorization, applauded the NBS for its farsightedness in establishing a Planning Office which worked directly with the senior management and urged the continuation of this effort. It was therefore with regret that the Committee noted that funds for the continuation of that Office were not included in the budget for fiscal year 1984. By a vote of the Committee, funds in the amount of $400,000 were included in the authorization bill and a minimum spending floor was included for this activity in that same amount.

EXCESS FOREIGN CURRENCY

The bill would authorize, $700,000 to be paid in foreign currency for expenses of the National Bureau of Standards incurred outside the United States.

OFFICE OF PRODUCTIVITY, TECHNOLOGY AND INNOVATION

The bill would authorize $3.8 million for the Office of Productivity, Technology and Innovation (OPTI). This Office serves as the focal point for efforts to develop policies and cooperative activities between government and industry to find solutions to the nation's problems of technological innovativeness and industrial productivity. The sum authorized would permit OPTI to move forward with programs of policy studies, the coordination of Federal patent policy, and voluntary conversion to the metric system.

In addition, OPTI initiated last year an Industrial Technology Partnership (ITP) Program designed to stimulate higher levels of private R&D investment in the U.S. A main focus of this program is to facilitate the greater use by the private sector of R&D limited partnerships. While not joint or cooperative research ventures, these partnerships are designed to foster large-scale R&D efforts that are beyond the risk threshold of individual companies. The use of R&D limited parterships minimizes antitrust and other legal problems, and also builds on existing tax incentives that reduce the risks associated with attempting to develop new advanced technologies.

As part of the ITP Program, OPTI is supporting the Center for the Utilization of Federal Technology (CUFT), established by the Stevenson-Wydler Technology Innovation Act of 1980. CUFT, which is located at, and is directly managed, by NTIS, monitors the technology transfer activities of Federal laboratories and disseminates technical information generated by them. Under the Stevenson-Wydler Act, OPTI is authorized to be funded in the amount of $74.0 million in fiscal year 1984. The Committee is disappointed in the Administration's lack of implementation of the Stevenson-Wydler Act.

NATIONAL TECHNICAL INFORMATION SERVICE

The National Technical Information Service provides the reports resulting from Federally funded research and development activities for sale to the public. In 1984 this is, for the first time, a fully self-sustaining service, with the estimated fee receipts of $29 million, providing the necessary operating funds.

The bill would authorize the sum of $175,000 to make the science and engineering literature of Japan available in the United States in English translation.

3. ADDITIONAL PROVISIONS OF THE BILL

Cost Recovery Authority (Sec. 103)

An amendment to the NBS Organic Act would authorize the Bureau to recover not only the operating costs but also the research and development costs for standard reference materials, calibration services and similar activities for which a fee is currently charged to the users. The Committee intends that operating costs recovered through fees should continue to be retained by the NBS, but that fee income exceeding operating costs must be returned to the U.S. Treasury.

Salary Adjustments (Sec. 106)

The bill would provide that if salary adjustments are required, they be proportionately absorbed if supplemental appropriations do not provide the necessary salary supplements.

Availability of Appropriations (Sec. 107)

A provision specifying that funds appropriated under this Act shall remain available as specified in the Appropriations Act is included in the bill.

Transfer of Funds (Sec. 108)

If transfers of funds amounting to more than 10 percent between the program categories reflected in the line items of the bill are essential to the operation of the National Bureau of Standards, notification must be made to the House and Senate authorizing committees.

Activities Performed for Other Agencies (Sec. 109)

The bill specifies that the Secretary of Commerce shall charge for services performed by the Bureau either at the request of another government agency, or to comply with any statute containing a provision which specifically names the Secretary or the Bureau to perform certain activities with, for, or on behalf of another government agency. This section also would permit the Secretary to waive any charge where the service rendered by the Bureau is such that the Bureau will incur only nominal costs in performing it. It specifies that costs shall be determined in accordance with subsection 12(e) of the Organic Act (15 U.S.C. 278b(e)).

4. COMMITTEE VIEWS

In addition to the foregoing considerations and analysis which are reflected in the bill, the Committee directs the attention of the National Bureau of Standards and the Secretary of Commerce to the following Committee Views and, where appropriate, asks the Bureau or the Secretary to take the required action.

CENTER FOR FIRE RESEARCH

The Committee strongly supports the continuation of the Center for Fire Research, proposed for elimination in the Administration's fiscal year 1984 budget request. This program provides the scientific and technical basis for the reduction of the Nation's fire losses and the cost of fire protection.

The National Bureau of Standards has been involved in fire research since its inception in 1901, as authorized by the Organic Act. The Center for Fire Research was established by the Federal Fire Prevention and Control Act of 1974 as a direct result of a 1973 Report of the National Commission on Fire Prevention and Control which stated that there was no existing organization conducting basic fire research.

The program's strategy is to develop the technical basis for fire hazard assessment in order to provide the fire community with new and improved practices for reducing fire hazards. In addition, as an integral part of the program, $2 million is provided annually to about 30 universities and organizations for fundamental fire research. These grants currently represent the only funding source for research through which our Nation's new fire scientists are trained.

The Committee believes that the private sector has neither the incentive nor the resources to conduct a comprehensive broad-based fire research program such as that existing at NBS. Furthermore, the Committee believes that research on subjects protecting the health and welfare of the Nation's citizens is a Federal responsibility and that the Bureau is a source of credible, impartial information in an essential area. The Committee has, therefore, restored funding for the Center for Fire Research in the sum of $6.4 million for fiscal year 1984.

CENTER FOR FIRE RESEARCH: TOXICITY STUDY

The Committee believes that the Center for Fire Research (CFR) performs a unique public service by conducting sophisticated, basic research on fire and fire safety, which would not be carried on by the private sector. The CFR has consistently conducted successful fire-safety research, and is recognized as a world leader in its field. The Committee is particularly concerned that the CFR's work relating to the toxicity of combustion products be continued. In view of the seemingly increasing threat to public safety of the danger of toxicity in fires, the Committee is restoring funding for the CFR to $6.386 million, so that it may continue its vitally needed research in this and other areas.

CENTER FOR BUILDING RESEARCH

The Committee strongly supports the continuation of the Center for Building Research which has been proposed for elimination in the Administration's FY 1984 budget request. Research conducted at the Center provides the technical basis for voluntary standards, building codes and specifications through development of improved measurement techniques, test methods, and technical data that are not available from other sources.

The Committee believes that the research performed at the Building Research Center is vital to public health and safety and is worthy of continued support. The program at NBS addresses complex technical issues affecting the entire building industry and results in recommendations which reduce the burden of unnecessary or ineffective building regulations while maintaining essential levels of safety. The Committee believes that the Bureau is in a unique position to provide impartial information in an important area of investigation.

The Committee is not convinced that the private sector would carry out the needed research in the building sciences or provide nonproprietary technical information where needed and has, accordingly, restored funding in the amount of $4.5 million for the Center.

The Committee believes that the services provided to the building community and the nation by the Centers for Building Technology and Fire Research within the National Bureau of Standards would be materially enhanced by broad-based building community input to their program development. NIBS, the National Institute of Building Sciences was brought into being by the Congress (Section 809, Public Law 93-383) for the express purpose of providing an authoritative national source of findings and advice to both the public and private sectors of the economy with respect to the use of building science and technology. The Committee feels that the Bureau should avail itself of this resource on an annual basis. A formal or informal agreement should be entered into by the Bureau and the Institute that establishes a mechanism for providing on-going building community input. The Committee will look forward to receiving from both organizations a joint report of progress and recommendation of any actions by the Congress that may be needed to make this cooperative endeavor more effective.

COMPUTER SCIENCE AND TECHNOLOGY

The Committee again reaffirms its belief that NBS has a direct role not only in standards setting for the rapidly developing field of computer and information technology but also in assessing and influencing the broader national impact of this field. The Committee believes that the mission of the Institute for Computer Sciences and Technology (ICST) is essential to the development and implementation of a coherent national information policy and to the management of Federal information resources.

The Committee remains concerned that NBS has not given high priority and adequate support to the functions and missions of ICST and that the Administration has been studying for approximately 18 months the appropriate organizational arrangement for ICST. On March 21, 1983 just prior to the NBS authorizing hearing on March 22, the Secretary of Commerce established a Policy Task Force on Telecommunications/Computers to: review all aspects of the Department's programs in telecommunications, information and computers, including the current organizational arrangements, budgets and Strategic Planning Objectives; and recommend whatever organizational changes may be necessary to achieve the defined objectives. The resulting decisions could have a significant impact on national information science and technology policy. Therefore, Members of the Science, Research and Technology Subcommittee requested that Deputy Secretary Fiske review with the Subcommittee the task force's recommendations and the Department's objectives in this area prior to implementation. The Committee directs the Department to formulate their recommendations concerning the organizational arrangements for ICST in a timely fashion so that ICST can accomplish its functions without further uncertainty regarding location and mission.

The Committee reiterates its position that ICST competence funded projects have made a significant contribution to the ICST mission and are necessary to maintain staff competence for both advisory services and ADP standards. In the Committee's Report No. 97-501 on NBS fiscal year 1983 authorizing appropriations, NBS was directed to provide ICST competence funding at a minimal annual effort of $700,000 for fiscal year 1982 and reasonable competence funding in succeeding fiscal years. This directive has not been fulfilled. The Committee expects ICST to receive competence funding and again directs NBS to provide ICST reasonable competence funding in fiscal year 1983, fiscal year 1984, and succeeding fiscal years.

The Committee continues to be concerned about the lack of a comprehensive information science and technology policy and the need to bring together public and private interests to discuss national information concerns in a cooperative forum. To initiate activity in this area and in keeping with the mission of ICST, the Committee directs the Institute for Computer Sciences and Technology to establish a forum to provide extensive interaction between appropriate governmental, education, scientific, industrial, commercial, and other private entities to:

1. assess the role and impact of standards on rapidly changing technologies such as microelectronics, supercomputers, and telecommunications;
2. assess current and projected developments in information science and technology including potential applications, and the projected need for changes in the Federal standard-setting and policy-making processes to be responsive to such developments and applications.

In carrying out this directive, the Committee requests that ICST: evaluate effective mechanisms for bringing together public and private interests to discuss national microelectronics and communications concerns in a cooperative forum; and determine effective mechanisms for forecasting the impacts of the rapid development of information technology and telecommunications and for articulating the need for national policies in light of such developments.

A progress report including preliminary findings and future plans to carry out this directive should be submitted to the Committee by October 25, 1984.

SCIENTIFIC COMPUTING CAPABILITY

The Committee is concerned that the Bureau's original plan to complete in fiscal year 1982 the acquisition of an upgraded central computing system to improve scientific computing capabilities was delayed by the Administration. As a result of this delay, the Department of Commerce was authorized to defer the fiscal year 1982 funds to enhance the NBS scientific computing capability to fiscal year 1983. In February, 1983, Department representatives briefed Committee staff on the Department's recommendations concerning the most cost-effective approach for meeting the scientific computing requirements of NBS and NOAA/ERL. At the February, 1983 briefing, the Committee was assured that the fiscal year 1982 funds of NBS and NOAA were carried over to fiscal year 1983 and adequate funds were available to implement their recommendation to establish in fiscal year 1983 one consolidated large computing facility to meet the scientific computing needs of both NOAA and NBS.

During the NBS authorization hearing on March 22, 1983, the NBS Director was asked to supply for the record information on the current status of the availability of funds for implementing in fiscal year 1983 the Department's recommendation to establish computing facilities to meet the scientific computing needs of NBS. The NBS response follows: "The Department of Commerce is preparing to purchase a scientific computer to be shared by NBS and NOAA. As part of the planning phase we are assessing resource availability from both organizations. Further details on funding implications will be available once this assessment has been completed".

In view of the fact that the Committee was assured in February, 1983 that the resources and computing facility would be available in fiscal year 1983, the Committee finds the NBS response unacceptable. Therefore, the Committee directs NBS and the Department of Commerce to provide the Committee by May 30, 1983 a specific response concerning the availability of funds in fiscal year 1983 to meet the NBS scientific computing needs and a timetable indicating when the computing facilities will be operational. In addition, the Committee directs the Bureau and the Department of Commerce to give the highest priority to obtaining the necessary scientific computing capability for NBS.

FORMAT OF BUDGET BOOK

In recent years the Committee's analysis of the Bureau's budget and program descriptions has proven to be difficult due to a difference in the line-item breakdown presented by the Bureau. The

Committee commends the Bureau for changing the fiscal year 1984 budget format to correspond more closely to the Committee's line-item program breakdown needs and directs the Bureau to continue to work with the Committee to further simplify the budget format.

In addition, this year, the budget for the Office of Productivity, Technology and Innovation was presented along the lines of global activities such as "productivity enhancement" and "policy implementation and coordination". Budget presentation in this format obscures the amount and scope of effort associated with specific activities of interest to the Committee, such as, patent policy, metric conversion, technology transfer, patent licensing, etc. Therefore, the Committee directs the Office of Productivity, Technology and Innovation to prepare future budgets in a format that will provide information on specific activities as indicated above.

DISSEMINATION OF COMPETITIVE ASSESSMENTS

The Office of Competitive Assessment which reports to the Assistant Secretary for Productivity, Technology and Innovation conducts medium to long-range assessments of the international competitiveness of specific sectors of U.S. industry, including the identification of implications for the U.S. economy and of policy options for dealing with competitive prospects. It also meets with representatives of the private sector to identify factors that influence private sector international competitiveness, and it identifies barriers impeding U.S. industries' ability to respond positively to long-term competitive problems and opportunities.

A competitive assessment is an evaluation of the competitive prospects of a specific sector of U.S. industry in the medium to long-range future based on quantitative analyses and an understanding of the forces driving the future of the industry in question. It consists of two parts: (1) sectoral analysis and forecast; and (2) policy implications.

The principal objectives of the Office are to increase the knowledge and awareness of high Governmental policy officials regarding the medium to long-range potential international competitiveness of specific sectors of U.S. industry, and to apprise them of the policy implications and policy options to deal with such potential outcomes through the performance of competitive assessments of various industrial sectors. Other objectives include: (1) enabling Government economic policymakers to incorporate a better understanding of future sector-specific impacts of macro government policies into the policy-making process; (2) improving Government economic policy and programs so as to facilitate the response of private industry to long term competitive problems and opportunities; and (3) communicating the results of competitive assessments to private industry in order to stimulate discussion and debate within sectors about the long-term strategic forces influencing the future international competitiveness of their businesses.

The Committee is concerned that the assessments being developed by the Office of Competitive Assessment may not be distributed in a manner so as to achieve maximum benefit from these studies.

The Committee requests that dissemination plans for these assessments be developed and provided. It is understood that the assessment on petrochemicals has been completed and that the assessments on civil aircraft and telecommunications are in progress. Other sectors being considered for assessment include: digital switching, machine tools/robotics, peripheral computer and telecommunication equipment, composites, ceramic and plastic engineering materials, information manipulation and distribution, international construction, telecommunication transmission systems, non-farming food products, pharmaceuticals, computers, energy storage and transmission equipment, banking and financial services, optical equipment and lenses, and industrial machinery components such as valves and bearings.

5. EXPLANATION OF BUDGET CATEGORIES

The detailed program activities and subactivities that would be performed under the proposed budget levels in the bill are described in this section.

NATIONAL BUREAU OF STANDARDS

1. MEASUREMENT RESEARCH AND STANDARDS (Sec. 101(a)(1))	$52,031,000

This activity encompasses a broad program of research in measurements and standards being performed by the National Measurement Laboratory. The subactivities include Fundamental Physical Measurements and Standards, Radiation Measurements and Standards, Analytical Chemical Measurements and Standards, Materials Characterization, Processing and Performance, Chemical Properties and Processes, and Measurement Technology Transfer. A description of these subactivities follows:

FUNDAMENTAL PHYSICAL MEASUREMENTS AND STANDARDS	$11,377,000

This program maintains and improves standards for the physical units of time and frequency, temperature, pressure, length, mass, voltage and electrical resistance. Measurements and calibrations made against these standards are disseminated to the point of use through transfer standards or other appropriate mechanisms. Virtually all types of industrial activities, research and development work in science and medicine, and the national defense system receive support from this program. Fundamental physical constants affecting broad areas of scientific endeavor and industrial activity are measured using the staff expertise and instrumentation available at NBS.

Recent accomplishments in this program include: completion of a proposal for the replacement of the current International Practical Temperature Scale for consideration by the International Consultative Committee for Thermometry; completion of the accurate frequency measurement of three lasers stabilized on lines in the visible spectrum of iodine to provide for the practical realization of an internationally proposed redefinition of the meter; and determination of the NBS primary standard units of capacitance and resistance to an accuracy of one part in 100 million to ensure consistency with the internationally accepted system. The scientific and technical expertise developed under this program is accessed by other Government agencies on a reimbursable basis. For example, the Department of Defense (DOD) has contracted with NBS to provide time and frequency measurements in support of timekeeping requirements for defense communications and the Global Positioning System. Additionally DOD has requested that NBS develop and evaluate frequency standards and provide very stable electrical transfer standards for use in calibrating military instruments and equipment. The Department of Energy (DOE) has contracted NBS to conduct research in vacuum measurement technology to provide vacuum standards for the various fusion research and development projects. NBS was requested to perform this research because of its staff expertise and unique capability in the development of fundamental standards and new measurement methods and because of requirements that measurements of other agencies be traceable to national standards.

Planned accomplishments in fiscal year 1984 include the following:

> Complete an operational intercontinental time transfer system with 10 nanosecond accuracy in order to fulfill NBS responsibilities for national and international time and frequency dissemination.
>
> Complete the automation of NBS' facility for measuring resistance standards in the range 100 ohms to 100 million ohms in order to provide industry with the required measurement accuracy.
>
> Complete construction of a prototype high accuracy automated balance (kilogram mass comparator) for improved maintenance of the U.S. national standards of mass.

RADIATION MEASUREMENTS AND STANDARDS $9,306,000

This program conducts basic and applied research in nuclear radiation physics, optical radiation physics, plasma physics, ultraviolet physics, electron physics, and nuclear structure in order to improve the understanding of the interaction of radiation with matter. Based on this research, NBS is developing standards for radiography, dosimetry, optical and ultraviolet radiation, radioactivity, gamma and X-rays, neutron beams and fields, and plasmas, as well as publishing critical data on atomic transitions. These standards contribute to the technical base for measurements related to the design, operation, and safety of nuclear power plants and for measurements made by such diverse groups as the electro-optics and communications industries, the photographic industry, the lamp and optical instrumentation industry, hospitals, and Defense standards laboratories.

Recent accomplishments in this program include: development of standards required by the American Society for Testing and Materials (ASTM) for surveillance radiation dosimetry of U.S. electric power reactor pressure vessels in order to enhance the useful lifetime of these vessels; determination of the accurate yield of chemical dosimeters required for photon and electron radiation therapy of cancer; and completion of the feasibility study of the use of interference-filtered silicon photodiodes to achieve the needed accuracy for the normalization of standard calibration lamps used in communications and the lighting industries. The scientific and technical expertise developed under this program is used to respond to the measurement requirements of industry and other government agencies on a reimbursable basis. An example of NBS research currently being conducted with private sector funding is measurement research for the nuclear reactor power industry in the area of neutron dosimetry measurements which are used to monitor pressure vessel integrity. A second example involves the radiation processing industry in the area of high radiation dose measurements where radiation is used for such diverse applications as medical instrument sterilization and curing the plastic coating of electrical wire. NBS also responded to the research and development requirements of the DOE in the area of fusion plasma diagnostics and the DOD in the area of long-wave infrared measurements for use in military surveillance activities. NBS was requested to assist industry and other agencies with radiation measurement problems because of its staff expertise and unique measurement capabilities involving standards for optical and ultraviolet, ionizing electron and neutron radiation. Additionally, NBS measurements establish traceability to national standards which is often a requirement in procurement and safety specifications.

Planned accomplishments in fiscal year 1984 include the following:

Develop gamma-ray emission-rate standards for determination of concentrations of radioactive elements as found, for example, in the toxic gaseous effluents from nuclear power plants.

Establish a new national standard, based on calorimetric measurements in water, of absorbed radiation dosage to enable improved accuracy and quality control in measurements of how radiation affects the human body, in such applications as radiation cancer therapy.

Develop laser light probes for measuring the properties of high temperature plasmas such as those produced by high power lasers and fusion devices that are being developed as energy sources of the future.

ANALYTICAL CHEMICAL MEASUREMENTS AND STANDARDS........................	$2,511,000

This program conducts basic and applied research that leads to the development of standards and measurement methods for high accuracy chemical analyses in support of many Federal programs including environmental pollution, toxic substances, and health services, and in the chemical, clinical, instrument manufacturing, and metals producing industries. Important decisions concerning the medical treatment of people or the abatement of pollution are based on chemical analyses, and the reliability of these analyses assumes great significance for both personal well-being and cost control. In addition to developing new analytical techniques, NBS also provides the means to assess their reliability by the use and issuance of Standard Reference Materials.

Recent accomplishments in this program include: development of an analytical methodology for the quantification of toxic organic vapors (perchlorethylene, vinyl chloride) at less than one-part-per-million level for application in industrial hygiene; investigation of the potential of negative chemical ionization mass spectrometry for the quantification of trace level nitrogen-containing aromatic hydrocarbons, such as aza-arene compounds, which are frequently toxic and representative of a class of compounds strongly suspected to be carcinogens; and the application of gas isotope dilution mass spectrometric and fusion techniques to the characterization of gases in metals and high technology materials. Based on the scientific and technical expertise developed under this program, NBS is able to respond to the research and development requirements of industry and other government agencies on a reimbursable basis.

The program also produces Standard Reference Materials (SRM's) which are provided on a reimbursable basis to industry and Government agencies for a wide variety of uses. In providing SRM's, this program analyzes samples and certifies their elemental or molecular composition. Examples of such SRM's include: gases in metals and other high technology materials which are used in the metals and aerospace industry; human serum which is used by the health and medical communities; and PCB's in oil and drinking water which are used by environmental, regulatory, and health groups. In all of these cases the respective SRM's provide the basis for assessing measurement accuracy and reference to the national measurement system.

Planned accomplishments in fiscal year 1984 include the following:

Complete development of methodology for neutron depth profiling of helium, bismuth, and nitrogen in solid materials to enable nondestructive three-dimensional compositional analysis of critical high technology materials.

Apply two-dimentional electrophoretic techniques to the quantitative analyses of proteins in order to establish an accurate basis required for the characterization of proteins in industry and clinical laboratories.

Perform research on absolute measurement methodology for the analysis of small gaseous molecules by laser absorption photometry in order to achieve the increased selectivity and sensitivity required for pollution abatement measurements.

Generate a predictive model to be used for reducing interference effects in laser enhanced ionization in flames.

MATERIALS CHARACTERIZATION, PROCESSING, AND PERFORMANCE.......... $15,827,000

This program is responsible for providing evaluated data, measurement methods, standards and reference materials, concepts, and other technical information to industry, Government agencies, universities, and other scientific organizations. The program supports generic technologies in materials in order to promote their safe, efficient, and economical use. Research addresses the science base underlying new and existing advanced materials technologies together with the associated measurement methodology. The program has four complementary components: materials processing, microstructure characterization, properties, and performance. Each of these components involve metals, polymers, composites, ceramics, and glass.

This program provides the measurement services needed for the optimization of materials processing, materials selection, new materials development, and performance in service. The expanding application of materials in our technologically based society requires more precise, accurate, and sophisticated measurement techniques to characterize important new materials. These applications also require better materials property specifications and data for the wide variety of materials currently in use. Materials standards and reliable measurements are needed to monitor performance characteristics and ensure equity in commerce. Increases in the productivity and efficiency of materials processes made possible by these measurements will improve the competitive position of the U.S. in world trade through the use of lower cost raw materials; more efficient processing; the reduction of process costs, including more efficient use of energy; and the reduction of loss through materials fracture and failure.

Examples of recent accomplishments in this program are: development of a high flux X-ray measurement system for real-time characterization of alloy microstructure to provide the fundamental science and measurement base for industrial use in quality control of alloys and in advanced and innovative materials processing; development of the relationships between elastic-plastic fracture parameters and applied strain for three dimensional flaws in steels (e.g. surface flaws) so that design curves, which are the basis for fitness of service codes, can be improved; and determination of the effects of microstructure and environment on fatigue performance of copper and steel alloys in wear applications to minimize costs of sudden failure in manufacturing machinery and ground transportation equipment. Based on the scientific and technical expertise developed through this program, NBS is able to respond on a reimbursable basis to: requirements of the ceramics industry in the area of materials processing through development of a formal cooperative program with the American Ceramics Society for collection and dissemination of phase diagram data; the needs of materials industries in the area of microstructure characterization for the structural integrity of metals through development of sophisticated measurement methods based on acoustic emission ultrasonics and the use of advanced computerized signal processing techniques; and the requirements of industry in the area of materials properties (wear and abrasion measurement and test capability) by providing both an abrasive wear reference material and, in conjunction with the American Society for Testing and Materials (ASTM), developing a new solid particle impact erosion test.

Planned accomplishments in fiscal year 1984 include the following:

Perform center and edge crack panel measurements to verify elastic-plastic fracture relationships among flaw size, applied strains, and material toughness for the development of fitness for service standards for critical structures.

Develop a technique for measuring delamination of polymer matrix composites under impact. This technique will provide data for design improvements to control this frequent cause of structural composite failure in service.

Measure low-energy vibrational density of states of atoms and chemical species bound at the surface of submicron metallic particles and catalysts. These measurements will provide information on the dynamics and chemical interaction potentials related to fundamental service conditions relevant to heterogeneous catalysis.

Determine the effects of microstresses induced by phase transformations or thermal expansion anisotropy on crack growth behavior in polycrystalline ceramics. This information will allow lifetime predictions to be made for structural ceramics where flaw sizes are of the same magnitude as the grain size.

CHEMICAL PROPERTIES AND PROCESSES.. $3,463,000

This program deals primarily with measurement of fundamental chemical processes, chemical and physical properties of matter, and how these processes and properties change with temperature, pressure, and composition. These measurements are important in a wide variety of applications, such as chemical and industrial manufacturing, in energy conversion processes, and in atmospheric reactions. Physical and chemical properties are measured and studied at the atomic and molecular levels in order to correlate such data with technologically important bulk properties and processes significant in the handling and production of chemicals and energy. Successful correlations will lead to predictive equations for property and chemical process data for materials and mixtures over ranges of pressure, temperature, and composition for which direct measurements are not available. These predictive equations will make it possible to provide data needed by industry for optimizing processes with respect to energy requirements and feedstock supply. The measurement methods, standards and data produced in this program are essential to many industries and Government programs; for the safe handling of potentially hazardous chemical materials; for resource management for the production and use of refuse derived fuels; for the development of laser and other weapons for defense; for the design of more energy efficient processes; for energy conservation in industrial plants, and for the provision of the scientific foundation for decisions concerning low-pollution reaction pathways, reasonable regulation and compliance demonstration.

Recent accomplishments in this program include: application of vibrational spectroscopy techniques to identify molecular fragments on catalytic surfaces and the mechanisms of reactions on these surfaces in order to provide data and models which will contribute to improved industrial catalytic processes; construction and testing of a heated shock tube for measuring the rate of oxidation reactions under severe conditions such as those found in chemical production and combustion; and evaluation of a model for predicting the energy release potential of inorganic compounds to assess the model's usefulness in hazard potential screening by the chemical and transportation industries. Based on the scientific and technical expertise developed under this program, NBS is able to respond, on a reimbursable basis, to the research and development requirements of various private sector organizations and other Federal agencies.

Planned accomplishments in fiscal year 1984 include the following:

Improve the accuracy of measurements of the sputtering yields for selected pure elements using low-energy ions as a basis for improving quantitative measurements of elemental composition versus depth needed to predict materials performance.

Relate the heats of formation of nucleic acid fragments to measured heats of combustion and solution in order to provide basic thermodynamic data needed by emerging biotechnology industries to determine reaction pathways and the feasibility of new biochemical processing techniques.

Apply the heated, single-pulse shock tube to the study of the stability of resonance stabilized free radicals to provide fundamental chemical kinetics data that determine reaction paths and affect the design of industrial processing methods utilizing alternate fuels.

Develop theoretical models for predicting the interaction energies and reaction pathways of complex organic molecules. This information is needed by the private sector in order to improve the efficiency and effectiveness of industrial chemical processes.

MEASUREMENT TECHNOLOGY TRANSFER.. $6,587,000

The three components of this program, the Measurement Assurance Program (MAP), Standard Reference Materials (SRM), and Standard Reference Data (SRD), are used to transfer NBS developed measurement techniques, standards, and data to industry, universities, and government.

The NBS Measurement Assurance Program provides service to ensure the quality of measurements in commercial and government calibration laboratories. In fiscal year 1984 the program will coordinate calibration services and tests that are performed on a reimbursable basis. In a typical year about three thousand calibration services are provided to about one thousand different, principally industrial, organizations. The program also provides for increasing the efficiency of dissemination methods for measurements requiring very high accuracy and/or close statistical control through the maintenance of Regional Measurement Assurance Programs (RMAP's). The 1984 budget proposes shifting the funding of appropriate aspects of this program to those who directly benefit from the service thereby eliminating the need for appropriated funding.

The Standard Reference Materials program determines the feasibility of producing new SRM's, assures that SRM's are available in a form to be effectively utilized by the scientific and industrial communities, conducts measurement technology transfer projects, and coordinates SRM activities with industrial trade associations, other government agencies, standards groups, and professional societies. Standard Reference Materials have been produced, certified, and issued by NBS since 1906 and provide benchmarks for calibration of instruments and measurement systems. SRM's help industrialists and technologists make effective use of materials through improved quality control over the production of goods. They also help assure equity in buyer-seller transactions, and assure the long-term adequacy and integrity of the measurement process.

The Standard Reference Data program provides scientists and engineers with critically evaluated physical and chemical data needed for the solution of problems in research, development, and engineering design in industry, government, and academic laboratories. The work is carried out in several data evaluation centers, located within NBS and in other institutions. These centers collect all reported measurements on materials and processes of interest, subject the chemical and physical data to critical evaluation and analysis by experts, develop appropriate models to predict the properties of substances that have not been measured, test the predictions with additional measurements, and produce compilations of data suitable for general industrial, scientific and engineering use.

Recent accomplishments in the Measurement Technology Transfer programs include the following: publication of a report summarizing the results of a pilot "reverse regional MAP" in DC resistance which will provide a technique for increasing the self sufficiency of secondary calibration laboratories; development of new calorimetry techniques for certification of heating values in fossil fuel reference materials; development of analytical methods for determination of vitamin D and lactose in dry milk and iodine in foods; installation of a fluid properties database in an on-line computer network to provide immediate access by the private and public sectors to reliable data for engineering calculations; and publication of a critical evaluation of rate constant data describing elementary reactions in the atmosphere with application to the prediction of stratospheric ozone depletion. Based on the results of completed research and standards development NBS currently offers reimbursable MAP and RMAP services to secondary standards laboratories in the areas of: mass; electrical units such as capacitance, resistance and DC voltage; temperature measurement through platinum resistance thermometers and laser power and energy. These services are offered to state, private, and industrial laboratories, most of which are members of the National Conference of Weights and Measures and the National Conference of Standards Laboratories.

Planned accomplishments in fiscal year 1984 include the following:

Publish a new edition of the Joint Army/Navy/Air Force Thermochemical Tables, the most widely used source of such data for industrial and military applications.

Develop a computerized database of physical and thermodynamic properties of organic compounds for use in chemical process design.

Complete development of a new series of low level radioactive natural matrix (lung tissue and soils) SRM's for use in monitoring nuclear power reactor sites.

Develop a series of new measurement methods involving several techniques including isotope dilution mass spectrometry, and neutron activation analysis for the analysis of trace-level impurity gases in high technology metal SRM's including specialty stainless steels, nickel-based alloys, zirconium alloys, and titanium alloys.

Complete development of the first SRM's (coal) for use in accurately determining the heating values of coals.

APPLIED MEASUREMENT PROGRAMS $2,960,000

This program is concerned with the development and operation of multi-disciplinary activities that optimize the use of all NBS technical resources in order to respond to specific national needs and to the long-term needs of industry. Efforts in this program are currently focused in two areas: Nondestructive Evaluation (NDE) and Recycled Oil.

Nondestructive evaluation is the process of determining the quality of a part or an assembly without damaging it. U.S. industry is increasing its use of NDE in the manufacturing process to improve product quality control, and to identify defective components early enough in the production sequence to avoid further costly processing. It is used extensively to detect incipient flaws and prevent catastrophic failure of in-service structures such as bridges, airplanes, pipelines, and power plants.

The program also develops standards and measurement services which will speed the adoption of new or improved NDE methods that offer enhanced quality assurance capabilities. Some of the new methods being addressed include acoustic emission testing for continuous monitoring of production line welding and in-service monitoring of such structures as bridges and pressure vessels, small angle neutron scattering for monitoring metal hardening processes and fatigue damage in high strength metals, and advanced X-ray diffraction techniques for determining residual stresses in metal components.

The development of new and improved measurement methods and standards by NBS will promote more reliable product quality control during production, conserve materials, increase the safety and reliability of in-service products, and increase the Nation's productivity. Product failures resulting from defects introduced during processing or manufacturing may be greatly reduced by eliminating defective materials before they are used to fabricate components and by testing components and products before they are sold and placed into service. This requires a quality assurance technology that is capable of economically assessing the condition of materials and determining whether they are suitable for their intended applications. In addition, the extended use of NDE techniques throughout industry for defect detection requires greater reliability and comparability of test methods.

Recent accomplishments in the NDE program include: development and experimental validation of a new theory that explains the frequency dependence of eddy current NDE to facilitate greater reliability and accuracy; successfully proving the feasibility of utilizing stressed metal plates with small machined flaws to calibrate optical holography NDE techniques; and providing the science base and measurement methodology needed to characterize surface defects in ceramic materials by optical scattering NDE. Such defects can lead to mechanical failure (cracking). The NBS developed capability in generic measurement standards has enabled the NDE program to respond to the needs of other Federal agencies and the private sector on a reimbursable basis. For example, NBS has evaluated low-energy X-ray radiography systems for real-time inspection of ordnance missile components for the Navy Department. NBS expertise is also being utilized to develop written specifications for NDE procedures to be used by DOD. The Welding Research Council sought NBS assistance in the selection of quantitative NDE methods for detecting and dimensioning girth weld flaws in oil and gas pipelines.

The Recycled Oil program supports the development of measurement methods and characterization procedures for re-refined oil for specific end uses such as fuel, engine, hydraulic, and industrial lubricating oil. Recent accomplishments in recycled oil include completion of the statistical analysis of oil base stock consistency and the performance of engine sequence testing.

Plans for 1984 in this program include the completion and verification of the final stage of engine sequence tests needed to complete this phase of the Recycled Oil Research Program started in 1978.

Planned accomplishments for the NDE program in fiscal year 1984 include the following:

> Develop improved measurement methods and standards for real time radiography applicable, for example, to imaging parts on a production line.
>
> Utilize small angle neutron scattering as a reference measurement method to determine distributed damage (many small flaws) in materials. Conventional NDE techniques will then be applied to demonstrate possible field measurement methods.
>
> Complete research for stable metal alloys needed to increase the range of NBS conductivity standards for eddy current testing.
>
> Develop NBS reference transfer standards for acoustic emission and ultrasonic testing.

2. ENGINEERING MEASUREMENTS AND STANDARDS (Sec. 101(a)(2)............ $22,881,000

This activity includes research and development work on Engineering Standards, on Safety and Performance Engineering, Technical Support to Industrial Productivity, and research in the Mathematical Sciences. A description of the activities in each subcategory follows.

BUILDING RESEARCH............ $4,509,000

This program addresses complex technical issues affecting the entire building industry and results in recommendations which reduce the burden of unnecessary or ineffective building regulations while maintaining essential levels of safety. This program benefits building owners, occupants, and the construction industry by (1) supporting an integrated, nonproprietary research effort aimed at removing technological market barriers (e.g. technical disagreement between buyer and seller associated with measurement of performance, such as measures of efficiency for building equipment) within the construction industry; (2) investigating major building and construction disasters (e.g. the walkway collapse in the Kansas City Hyatt Regency in 1981 and the East Chicago Indiana ramp collapse in 1982); (3) providing expertise and support to Federal agencies with building concerns (e.g. OSHA, GSA, FEMA, and the White House); and (4) providing nonproprietary technical information for the development of voluntary standards for buildings by organizations (e.g. the American Society for Testing and Materials, American Concrete Institute, American Society of Heating, Refrigerating and Air Conditioning Engineers, model building code organizations, etc.).

In response to the National Earthquake Hazards Reduction Act, this program also provides the technical support for the development of seismic design and construction provisions. (NBS has directly supported earthquake related research within its appropriation at an annual level of $475,000.) Quality assurance is also provided for 580 public and private laboratories nationwide that are relied upon by owners, designers, builders, and state and local governments for measurements of the properties of materials for buildings and transportation facilities. Private sector R&D and innovation are stimulated by this program's development of authoritative, non-prescriptive, measures (i.e. measures based on performance rather than fabrication process) for building materials, systems, and components. Lastly international activities include interacting with peer organizations in all developed and most underdeveloped countries in cooperative programs of building research and representing the U.S. building community in international building standards activities to assure the international competitiveness of U.S. construction products and services.

This program's results are used to improve Federal, state, and local government codes and specifications which lead to: (1) reduced cost of buildings; (2) assurance that cost effective, innovative materials and components deliver their intended service lives; (3) prediction of thermal, lighting, and acoustical properties of buildings for reduced design and construction costs; (4) technical basis for test methods for building equipment; (5) greater building reliability and durability; and (6) reduced losses from high winds and earthquakes.

Research conducted in this program has led to a number of recent accomplishments. For example, this program provided the technical basis for the recently revised standard of the American National Standards Institute, Minimum Design Loads for Buildings and Other Structures. This standard will result in the significant reduction of the design and material cost of buildings while providing more consistent levels of safety. Mechanisms of crack initiation and growth in concrete have also been identified in order to predict failure modes for all structures built of concrete. The basic scientific capabilities developed under this program have also enabled NBS to respond to the needs of other Government agencies and the private sector on a reimbursable basis. For example, in response to the National Earthquake Hazards Reduction Act the Federal Emergency Management Agency has supported the NBS development of procedures for assessing the technical adequacy of tentative seismic design provisions for buildings. DOE has funded the development of measurement techniques for evaluating the resulting energy conservation of weatherization retrofit options for residential structures. Results using these techniques demonstrated that an average reduction in space heating fuel consumption of 41 percent could be achieved at an average weatherization cost of less than $2,000 for a typical house built before the early 1970's.

Planned accomplishments in fiscal year 1984 include the following:

Establish performance measurements, required to interface engineering standards to computer-aided building design programs, that allows for interchangeability and updating of the standards.

Develop probability based criteria for the safe and economical design of curtain walls subjected to environmental loads such as wind, rain, and ice. Curtain wall failures have increased from 15 percent of all building failure claims in 1960 to 33 percent in 1980.

Establish analytically and experimentally the effect of thermal mass on the heating and cooling leads in buildings.

Develop a stochastic model for the degradation of polymeric building materials taking into effect the combined effects of ultraviolet light, heat and moisture.

SIGNALS AND SYSTEMS METROLOGY.. $5,726,000

This program provides national reference standards, measurement methods, supporting data and traceability of measurements to national standards for removal of marketbarriers (e.g. technical disagreement between buyer and seller associated with measurement of performance) in areas of fast signal acquisition, processing, and transmission; electrical power systems; and electromagnetic interference. Activities include: (1) advancing basic measurement science to enable accurate measurement of such electrical parameters as voltage, current, electric field, magnetic field, and power; optical fiber bandwidth, attenuation, and core diameter; and laser power and energy; (2) developing measurement methods for electrical quantities such as power, high voltage, high current, microwave parameters, and electromagnetic field parameters, and for electrical systems such as antennas and digital electronics; and (3) providing the technical and scientific information for the development of voluntary or de facto standards.

Signals and systems metrology serves nearly the entire electronics industry and directly affects a large portion of our society. For example, the calibration of every watt-hour meter on every home and company in the U.S. is traceable to standards developed by this program. Equity and efficiency in commerce as well as quality in manufacturing electronic systems such as microwave equipment, lasers, antennas, and optical fibers are facilitated by standards, measurement methods, and measurement services based on advances in measurement science achieved in this program.

The rapidly growing satellite-communication and optical-fiber industries utilize measurement methods developed and evaluated in this program. Such forefront-technology industries require highly advanced measurement methods relating industrial measurements to national standards delivered in a timely manner for the efficient conduct of commerce. NBS research on measurements at the limits of speed, sensitivity, and accuracy supports private sector leadership in computers and telecommunications—areas in which U.S. industry is experiencing severe international competition.

Private sector and Government development of safety standards for microwave equipment, including communications systems and appliances, and for laser systems used in industrial, commercial, and military applications requires measurement methods and physical standards developed in this program.

Planned accomplishments in fiscal year 1984 include the following:

Complete a digitally synthesized standard waveform generator capable of producing sine and other selected waveforms with an accuracy of 500 parts per million over the frequency range 10 hertz to 20 kilohertz. This is necessary for measurement services supporting modern electronic instruments and automatic test equipment.

Develop an integrated circuit sampler for on-chip measurements with resolution of 3 picoseconds or better to extend ultra-high-speed digital waveform measurements and analysis to support single-mode optical fiber communication systems and laser photochemistry research.

Develop and implement techniques to increase the dynamic range of attenuation and reflection coefficient measurements with a 6-port system to 80 decibels, required to provide the efficient, automated measurements necessary to support modern high-performance communications and military systems.

Extend NBS optical fiber measurements to serve the anticipated second-generation fiber systems operating at longer wavelengths (lower frequencies) for reduced attenuation over distance, enabling longer distances between repeaters in communications lines.

Complete development of electric and magnetic field probes for the 1 to 100 megahertz range. The probes will enable accurate measurements required to identify and resolve problems involving electromagnetic interference, which increasingly threatens the functioning of all modern electronic systems.

CHEMICAL ENGINEERING METROLOGY	$3,771,000

This program provides the chemical process and associated industries with the underlying scientific and chemical engineering measurement science, key chemical properties data, and predictive methods that enable these industries to calibrate their measurements relative to national standards for equitable exchange of goods in commerce and to efficiently design processes and plants.

This program develops accurate measurement techniques, traceable to NBS standards, for flow rate, volume, and density. These techniques are used by U.S. industries (e.g. chemical, petroleum, utilities, beverage, etc.) and state governments to assure that goods transferred in commerce are accurately measured.

The data portion of this program places emphasis on the development of critical thermophysical properties data and predictive models that extend beyond the measured data. The chemical industries use this data for efficient process and plant design.

The measurement portion of this program places emphasis on the development of new flow measurement techniques for mixtures of solids and fluids, and on other critical process measurements such as flow stream composition, temperature, viscosity, and density. Special emphasis is being given to industrial measurements which are made in harsh environments, such as high temperatures and pressures. In addition, this program is developing measurement services and techniques for measurements of liquids and gases needed for diverse process control and equity in trade. Improved predictive methods for heat and mass transfer in chemical reactions are also being developed. These results are essential to support the increasing use of feedstocks derived from the heavier fractions of crude oils and solids such as coal, biomass, tar sands, and shale.

The chemical process industries have annual sales exceeding $160 billion and constitute an important component in the international balance of trade. However, the U.S. share of world trade has dropped from 20 percent to 14 percent in the last ten years. This sector of U.S. industry spends over 10 percent of its annual gross sales on capital investments. Through the provision of improved data, measurements and predictive techniques the technological impacts of this program will reduce capital costs for new equipment and plants, save raw materials and reduce product energy requirements for new and existing plants, reduce waste products and environmental pollution, and provide equity in the marketplace.

Recent accomplishments include: the publication of a manual of custody transfer measurement methods for liquefied natural gas for use by buyer and seller in the international market: the development of the scientific basis, research facility and measurement techniques to define the behavior of the solid phase fraction in solid liquid flows; and the development of an optical fiber thermometer which may serve as a new and more accurate temperature standard and will permit the monitoring of industrial process environments at high temperatures in erosive/corrosive fluids.

Planned accomplishments in fiscal year 1984 include the following:

Develop measurement methods for industrial chemical mixers in order to establish a scientific basis for mixer performance standards. This will provide standardized test procedures, performance specifications, more efficient design criteria and lower energy costs.

Develop a multiangle scanning laser absorption technique to provide temporal and spatial measurement of composition and temperature in a chemically reacting system such as a combustor in order to establish a basis for optimizing these reactions.

Perfect a new acoustic measurement technique to determine thermophysical properties of industrially important gases to significantly improve the internationally accepted value of the universal gas constant.

Characterize the accuracy and stability of an NBS developed fiber optic probe to measure temperatures to better than 0.05 percent in the range from 600 to 2000° C and assess the potential of this probe as a new high temperature standard. This extends current high temperature capabilities by 500° C.

ENGINEERING AND PRODUCT STANDARDS	$3,572,000

This program formulates and implements policy guidelines related to national and international standardization, laboratory accreditation, and legal metrology, and maintains coordination with domestic, foreign, and international treaty and non-treaty organizations concerned with standardization and related measurement activities.

First, the program addresses Departmental responsibilities for implementing the Trade Agreements Act of 1979, concentrating on standards which constitute unnecessary technical barriers to trade, such as different national standards for the same product as opposed to a single internationally accepted standard. U.S. industry requires rapid and accurate information on foreign standards, certification requirements, and proposed regulations in order to establish competitive positions in the markets of other countries. Efficiency of U.S. production, competition, and product distribution are dependent on accurate, quick-response information on domestic and international standards and related activities. To provide for these needs, the program operates the National Center for Standards and Certification Information.

Second, the program provides overall management, planning, policy development, impact analysis, and coordination of the Department's involvement with engineering standards and information; coordinates standards policy, especially with respect to voluntary standards, among Federal agencies; and advises management on the resolution of standards issues. The Standards Assistance and Management Information activity develops data on participation by NBS staff members in domestic and international standards committees.

Third, this program serves as the national focal point for promoting high caliber performance by testing laboratories which voluntarily seek accreditation. Testing laboratories perform an essential service in the national engineering standards system and are becoming increasing important in supporting U.S. industries for acceptance of their goods in international trade. NBS develops performance criteria, establishes examination methodology, qualifies examiners, conducts workshops, and makes recommendations for accreditation to the Secretary of Commerce. Accredited laboratories provide assurance that products, including materials, components, and systems, meet the criteria stated in engineering and product standards.

In addition, the program supports the legal metrology (i.e. weights and measures) system of the United States domestically and internationally, by providing the required measurement technology to the States. In fiscal year 1984, NBS will issue a second grant as well as provide technical assistance to the National Conference of Weights and Measures for the continued development of a national training program. This training program will be used by State and local governments to provide primary instruction in weights and measures regulation and inspection. Other activities include administering the National Conference of Weights and Measures; providing traceability of state mesurement standards to the national standards at NBS; and promoting uniformity through model laws, regulations, and standards. The program is also responsible for conducting the meetings of U.S. working groups of the International Organization of Legal Metrology to draft international recommendations covering instruments used in commerce.

Recent accomplishments of this program include: (1) completion of the design of a quick retrieval system for standards information stored on microfilm/microfiche; (2) an increase to three in the number of countries with which the U.S. has reciprocal acceptance of nationally accredited laboratories; and (3) implementation of the start-up phase of a "National Type Evaluation Program" to facilitate interstate and international acceptance of commercial weighing and measuring equipment based on standardized testing procedures and criteria, and evaluated in authorized testing laboratories. Based on the technicial expertise developed under this program, NBS has been able to offer Laboratory Accreditation Programs (LAP's) on a reimbursable basis for thermal insulation, concrete, carpets and stoves. In addition, a LAP for personnel dosimeters has been developed in conjuction with the Nuclear Regulatory Commission and private sector laboratories engaged in radiation measurements. These services are provided by NBS because of its unique measurement capabilites and its responsibility to assure Federal utilization of private sector standards and related activities.

Planned accomplishments for fiscal year 1984 include the following:

Complete design and pilot testing of the quick retrieval information system to handle date inquiries concerning standards and related matters.

Implement the operational phase of a "National Type Evaluation Program" for the acceptance of weights and measures devices on a national basis.

MATHEMATICAL SCIENCES	$5,303,000

This program ensures that the most appropriate mathematical, operations research, computational, and statistical procedures are available for use in NBS technical programs. This program develops widely used mathematical methods in such areas as: mathematical modeling, nonlinear mathematics, computational techniques, graphics for analysis of complex data, symbolic manipulation and nonnumerical processing, discrete mathematical models, linear programming, network optimization, statistical experiment design, robust statistical methods, statistical modeling, time series analysis, and statistical control of measurement processes. In addition, this program provides advice and assistance to scientists and engineers at NBS by acquiring, adapting, developing, testing, evaluating, and documenting scientific computing software packages and assisting in their use in NBS research programs.

Recent accomplishments in this program include: the testing and compilation of an accessible library of optimization codes for NBS users; the development of versatile computational algorithms which make extended numerical precision routinely available to laboratory scientists; the application of specialized statistical procedures for keeping track of correlated measurement errors which occur in modern automated procedures for standards measurements; the development and documentation of computerized algebra and data manipulation used in interactive graphics and in solving nonlinear dynamic systems; the review of generally available high-quality software and the enhancement of mathematical and statistical software libraries; and the acquisition, development, and testing of mathematical algorithms for use on powerful modern scientific computers incorporting vector or parallel processing to assist NBS users of such facilities. Based on the expertise in network modeling and linear programming developed under this program, NBS also has been able to perform on a reimbursable basis specialized modeling and software tasks for DOT and DOE, in instances where the available private sector consulting firms could not avoid a conflict of interest. This program provided the DOT's Paratransit Integration Program with prototype automated procedures for routing, scheduling, dispatching, and bookkeeping functions for small unscheduled paratransit systems operated by local governments. For DOE's Energy Information Administration, NBS developed a large computer-based mathematical model of economic equilibrium within the U.S. natural gas market, which will be used to analyze the impact of alternative deregulation strategies.

Planned accomplishments in fiscal year 1984 include the following:

Develop improved relational database structures as required, for example, in recording and graphically reproducing metal-alloy phase diagrams. In this way data sets can be transmitted among laboratories from a central data bank with the form of the data items explicitly machine-readable.

Develop statistical methods for critically examining sources of systematic error in precision measurements. These methods are required, for example, to assure temperature transfer accuracy in the low temperature range to high technology laboratories using cryogenic equipment.

Co-author with a Canadian laboratory a handbook on statistical methods for certification of reference materials.

Acquire and develop software for an interactive graphics system to be operated as part of NBS' central scientific computing facility. This system will greatly enhance mathematical model evaluation and understanding by providing scientific computing users with necessary graphics services for improved data analysis and display.

TECHNICAL REIMBURSABLE SERVICES.. NONE.

This program is totally supported on a reimburseable basis and includes funding for the NBS Office of Energy Related Inventions (OERI) and the NBS Law Enforcement Standards Laboratory (LESL). OERI was established within NBS under the terms of Section 14 of the Federal Nonnuclear Energy Research and Development Act of 1974. OERI, which receives funds from DOE, is responsible for evaluation of energy related inventions, particularly those submitted by individual inventors and small companies. OERI is also responsible for outreach activities aimed at bringing the program to the attention of inventors and small businesses. The evaluations, which are performed by NBS staff and outside consultants, are based on three general criteria: technical feasibility, potential energy-conservation or supply impact, and commercial feasibility. Inventors are notified of the results of the evaluation in each case.

The primary mission of LESL is to develop performance standards to assist state and local governments in the cost-effective procurement of equipment suitable for the needs of law enforcement agencies. In addition to conducting research and developing highly technical guidelines for law enforcement equipment, LESL also issues technical research reports and data of a tutorial nature to assist personnel in the selection and application of specific equipment. Funding for these activities is provided by the Departments of Justice and Transportation and the Defense Nuclear Agency. These agencies rely on the scientific and engineering expertise of NBS to address problems of the criminal justice system and public safety.

A number of accomplishments were recently achieved in this program. For example, OERI provided over 1,000 evaluation reports to inventors in fiscal year 1982. OERI also sponsored five regional innovation workshops and the formation of a National Congress of Inventor Organizations. With support from OERI, an Office for Support of Technological Innovation (OSTI) was established by the American Association of Engineering Societies. The new office is designed to stimulate innovation by the Nation's engineering community and provide a national information service to all inventors. As requested by the National Highway Traffic Safety Administration, LESL has developed a model specification for voluntary use by state and local governments in the purchase of radar units that are suitable for reliable use in police traffic control. The credibility of speed measuring radar devices has become a national issue since a Florida court questioned the accuracy of such devices. In addition, LESL developed a user guide, published by the National Institute of Justice, which provides a valid basis for the selection of body armor for police.

3. COMPUTER SCIENCE AND TECHNOLOGY (Sec. 101(a)(3) $11,500,000

The goals of this activity are to: (1) develop, issue, and maintain standards and guidelines for the most effective and efficient purchase, lease, maintenance, operation and utilization of automatic data processing (ADP) equipment by Federal agencies; (2) provide technical support to international standards organizations so as to ensure that international ADP standards do not form trade barriers; and (3) expedite the development of voluntary standards leading to "off-the-shelf" products for the purpose of increasing the productivity of both the public and private sectors through the effective use of information technology.

The specific objectives are to:

Establish close communications with Federal agencies, State and local governments, and large private-sector ADP users to determine the needs for standards, guidelines, and "off-the-shelf" technologies.

Develop and maintain a comprehensive plan for the development of Federal ADP standards and guidelines.

Provide advice on management issues related to the introduction, use and evaluation of new information technologies.

Develop cooperative testing programs with industry to ensure that U.S. products meet international standards.

Conduct technology forecasts to anticipate future needs for Federal standards and guidelines.

Conduct whatever research is necessary to ensure that needs are met with technically sound standards and guidelines.

Report annually to OMB and the Congress the progress of the standards program.

This program is conducted under several authorities. The Brooks Act (Public Law 89-306) provides for the economic and efficient purchase, lease, maintenance, operation, and utilization of ADP equipment by Federal agencies. It assigns to the Secretary of Commerce the responsibility to develop and recommend uniform Federal ADP standards, to provide ADP scientific and technological advisory services to Federal agencies, and to undertake the necessary research in computer science and technology. Executive Order 11717 transfers the responsibility for developing Federal data standards from OMB to NBS. OMB Circulars A-108 and A-71 (TM-1) assign to the Department of Commerce direct responsibilities for issuing standards and guidelines on computer and data security.

In fiscal year 1983, the Institute for Computer Sciences and Technology (ICST) will continue to focus its technical efforts in the areas identified in the ICST Fiscal Year 1982 Annual Report. These areas help users to: (1) interconnect the products of different manufacturers through networks; (2) plan for, evaluate, select, and use computer resources throughout the system life cycle; and (3) use computer resources safely, avoiding fraud, waste and abuse.

Recent accomplishments include:

Led the development of a computer network protocol standard (transport layer) and achieved agreement in the International Organization for Standardization (ISO) to adopt it as a draft international standard.

Initiated a cooperative program to test network prototype standards; to date over 100 user and manufacturer organizations have expressed interest in participating in the program.

Completed a message format standard to facilitate message exchange between different systems; seven major vendors of message services have announced intention to implement.

Issued a guide to the selection of local area networks, focusing on how to establish requirements and evaluate systems.

Issued standards for magnetic tape cassettes and tape cartridges to improve information interchange.

Published a cost/benefit analysis describing the expected impact on Federal users of changes in COBOL proposed in the voluntary standards arena.

Published a technology forecast for information technologies which served as a basis for the ADP 5-year plans of several large Federal agencies.

Developed a file transfer standard to enable network users to transmit data between file systems on different host computers on a network.

Developed a guide to software operation and maintenance to help agencies correct errors, improve software, and relieve the heavy cost of software maintenance over the entire software life cycle.

Issued a guide to ADP contingency planning to help Federal managers plan for continuity of ADP services and organizational activities despite potential interruptions.

Established a teleconference network with State and local governments.

Planned accomplishments for fiscal year 1984 are to:

Issue an updated and expanded technology forecast with contributions by other major Federal agencies.

Issue guidance on management issues relating to end-user computing.

Complete functional specifications for a data dictionary system in support of U.S. computer industry domestically and in world markets.

Conduct a series of workshops for U.S. computer manufacturers on implementing international protocol standards.

Establish a teleconference network with major industry ADP users.

Issue guidelines on the certification and accreditation of computer systems, a management process for evaluating and reviewing computer security.

4. CORE RESEARCH PROGRAM FOR INNOVATION AND PRODUCTIVITY (Sec. 101(a)(4)) $14,356,000

The Bureau Core Research Program for Innovation and Productivity for fiscal year 1984 would include work in four areas: Very Large Scale Integrated Circuits (VLSI); Automated Manufactureing, Robotics, and Metals Processing. With the exception of Robotics, the effort in each area would continue approximately at fiscal year 1983 levels.

This program of research is geared toward removing technological barriers that would otherwise significantly restrain the introduction of new products and processes. Projects are identified and undertaken on the basis of their potential utility for industry. The following criteria are applied in project selection: (1) Opportunities must already be recognized by industry; (2) advancement must depend on the removal of a scientific or technological barrier; (3) the solution must have potentially significant impact on the economy and on industrial productivity; and (4) the solution must require the Bureau's exceptional expertise in measurement and materials.

The goal of this subactivity is to develop measurement and standards-related services and generic technologies important for industries affected by emerging high technologies. The objectives include:

Carry our fundamental material science research related to the advanced industrial metals processing techniques of rapid solidification, alloy coating production and alloy phase diagrams.

Provide national reference standards, measurement methods and supporting data for the removal of market barriers for buyers and sellers of semiconductor production equipment, materials, and devices with emphasis on emerging technologies such as very large scale integrated (VLSI) circuits.

Provide the scientific and technical base and the technical assistance and leadership which will permit the private sector to adopt interface standards for elements of automated manufacturing systems for discrete parts.

Provide measurement methods and standards for the units of length, mass, and their derived quantities such as force and acceleration, which are required to support the national measurement system and, in particular, those that are required in automated, manned, or combined man-machine modes of mechanical manufacturing.

Operate an automated manufacturing research facility and conduct related R&D work that will enable the investigation of the applicability of hierarchical controls systems or modularity concepts for robotic systems and contribute to the development of robotics technology.

MEASUREMENTS AND STANDARDS FOR ADVANCED METALS PROCESSING... $700,000

This program focuses on determining the structure and properties of metals experiencing advanced processing techniques of rapid solidification and alloy coating. Rapid solidification is the high speed transformation of metal from a liquid to a solid state by atomization, melt spinning, and directed high energy surface melting. Alloy coating is the formation of alloy surfaces on less expensive substrate materials thereby providing improved corrosion and wear resistance with greatly reduced use of critical alloying elements. Alloy phase diagrams provide graphic displays of the phases produced when two or more metals are combined. Phase diagram information allows prediction of the composition and properties of metal combinations under changing conditions and is instrumental in efficient selection, use, and processing of alloys, including design of new alloys and the development of novel rapid solidification and alloy coating processes. The new rapid solidification and coating processing methods are more efficient than existing technologies and are currently being developed by industry for specialized applications related primarily to defense and space needs.

This program is aimed at providing the measurement methods, standards, and data bases that will allow more rapid industrial scale adoption of innovative metals processing technologies which can reduce processing costs by as much as 10 to 15 percent in large segments of the metals industry. The segments of industry most affected will be the specialty alloys industries, especially steel and aluminum, and some of the major manufacturing sectors including automobile, truck, and aircraft manufacturers, metallic coatings and plating industries, and aluminum and steel foundries. Finally, advances in these technologies will aid development of substitutes for scarce metals and reduce dependence upon unreliable foreign sources of alloy materials not found in the United States.

Accomplishments of this program include the development of unique facilities for rapid solidification, alloy coatings, and alloy phase diagram studies. Facilities are now available for measurements on all three major types of rapid solidification: powder production, ribbon production, and surface treatment. Research on characteristics of new types of alloys have been made possible by cooling liquid metal ribbon rapidly enough to produce metallic glass, and by electron beam surface melting followed by rapid cooling to freeze-in alloy compositions not otherwise attainable. Using an atomization technique, submicrometer size powders have been formed whose characteristics and microstructures have been examined to determine the effect of processing conditions on individual particles. Electrodeposited alloy coating techniques have been used to produce nickel-phosphorus metallic glass coatings with improved wear and corrosion resistance. This program has provided reimbursable services to other Federal agencies, such as DARPA, and to industrial organizations, such as the American Electroplaters Society. For example, DARPA requested that NBS investigate the extent to which it is necessary to invoke non-equilibrium solidification theory in order to understand and control the special alloys and microstructures produced by rapid solidification. NBS' unique combination of expert theorists, advanced equipment for characterization of alloy microstructure, and phase diagram data evaluation specialists led to the finding that a number of the unusual features of rapidly solidified alloys, including increased homogeneity and expanded ranges of solid solubility, can be predicted on the basis of conventional solidification theory without requiring special non-equilibrium measurements and considerations. The American Electroplaters Society requested that NBS make measurements on pulsed-electrodeposited nickel-chromium alloy coatings studied at NBS. Because of its unique experience in working with these coating techniques, NBS was asked to evaluate the feasibility of using this process for producing corrosion resistant coatings for protection of steel and other metal substrates.

Planned accomplishments in fiscal year 1984 include the following:

> Produce high quality research samples of rapidly solidified aluminum alloy powders and relate structural characteristics to alloy compositions, particle sizes, and cooling rates in order to allow predictive modeling and process control for production of innovative metal alloys with improved properties.
>
> Determine relationships between electrodeposition processing parameters and the corrosion, wear, and mechanical properties of pulsed-electrodeposited nickel-phosphorous metallic glass coatings to provide alloy coatings having improved reliability.
>
> Complete evaluations of ten aluminum, iron, and titanium based binary phase diagrams. Implement an interactive computer program for the optimization of ternary system phase diagrams based on three evaluated binary systems to provide important data for alloy design and control of innovative metals processing techniques by industry.

SEMICONDUCTOR PROGRAM $5,489,000

This program provides measurement capability and physical standards that remove market barriers for semiconductor production equipment, materials, and devices. In this case market barriers would encompass those areas of technical disagreement between buyer and seller associated with measurement of characteristics such as dimensions of integrated circuit elements. Activities include (1) providing the scientific and technological information necessary for development of voluntary or de facto standards; (2) advancing basic dimensional and materials measurement sciences necessary for setting and satisfying product specifications; and (3) developing measurement methods, physical standards, and supporting data. Areas of emphasis for this program are: electrical characterization of defects; insulators and interfaces; micrometrology; test structures; device metrology; and modeling of devices and device phenomena.

A major component of this program addresses new measurement science for Very Large Scale Integrated (VLSI) circuits. The greatly reduced dimensions (micrometer and submicrometer i.e. approaching the size of less than a hundredth of a diameter of a hair) and the vastly increased complexity of these circuits require tighter control of dimensions, materials purity, and other parameters, as well as new testing concepts. New measurement science is needed to remove market barriers and reduce transaction costs between manufacturers and buyers of semiconductor materials and production equipment, and between manufacturers and buyers of the final integrated circuits, transistors, and other semiconductor devices. All industries employing these advanced devices are affected, including the automobile, computer, communications, aerospace, and defense industries. Program results will also contribute to productivity improvements in manufacturing processes and to the efficiency of government operations that employ such devices. These efforts will assist U.S. industries in meeting foreign competition from such countries as Japan, West Germany, the United Kingdom, and France whose governments are spending an average of approximately $100 million each per year on semiconductor research.

Research conducted in this program has led to a number of recent accomplishments. One example is the demonstration of improved test structures for measuring properties of thermal oxide layers in microelectronic devices. These measurements are critical to the performance of all integrated circuits. This program has also developed methods for determining the geometry of nonvertical submicrometer line edges to allow accurate linewidth measurements on circuit elements with such edges. These measurements are necessary for advances in integrated circuits. In addition, techniques for comparing two-dimensional physical models with measurements of the electrical properties of integrated circuits have been determined to establish a better tie between theory and measurement. The fundamental capability developed with appropriated funds also enabled NBS to respond to the needs of other government agencies and the private sector on a reimbursable basis. For example, this program has produced Standard Reference Materials (SRM's) for assessing the dimensions of photomasks. These SRM's, which have been sold to more than 80 industrial facilities, are critical for the production of all semiconductor integrated circuits. With support from the DOD, this program has developed, via a computerized network, integrated-circuit test structures for use by defense and commercial manufacturers and their buyers in determining the value of contact resistance within integrated circuits. DOD requested NBS' assistance in this area because of its technical expertise and neutral role in developing measurement techniques, essential aspects in removing market barriers, that are not available from any of the directly interested parties.

Planned accomplishments in fiscal year 1984 include the following:

Compare ellipsometric (optical) and electrical measurements with physical/chemical analysis of defects and impurities in oxides and interfaces as a critical step toward improved measurements. These measurements are important for metal-oxide-semiconductor (MOS) integrated circuits, the fastest growing part of the total semiconductor market.

Develop measurement procedures for lines patterned in thick layers of optical and e-beam resist, metal, and silicon-oxide material required for advanced integrated circuits.

Verify accuracy of a coupled equation two-dimensional metal- oxide - semiconductor - field - conductor - transmitter (MOSFET) simulation computer code, required to interpret measurement data on realistic VLSI-type devices.

Evaluate the potential of using a thermal test chip as the standard for measuring the effectiveness of VLSI packages in dissipating the large amount of heat generated by complex VLSI circuits. The results will be used by buyers and sellers to evaluate integrated circuit packages.

AUTOMATED MANUFACTURING INTERFACE STANDARDS.............................	$1,396,000

This program carries out scientific and technical activities that enable the private sector to adopt interface standards for elements of automated manufacturing systems for discrete parts. These activities include fundamental measurement and engineering science research in such areas as artificial intelligence, hierarchical control theory, control systems architectures, robot sensors, and software engineering. In addition, these activities will include full-scale, real-time experimental testing of the theories and concepts developed in this program on the NBS Automated Manufacturing Research Facility.

Other program efforts include working with consortia of private sector organizations, standards-writing bodies and other Federal agencies as a knowledgeable, neutral expert. These interactions are required if standards that protect proprietary interests are to be developed and made available in a timely manner. This timely development of standards facilitates the rapid automation of this country's discrete parts industries.

The completely automated small-batch manufacturing system or flexible manufacturing system consists of a series of elements, such as metal cutting machines, computers, terminals, robots, conveyers, measuring or inspection systems, and a host of other mechanisms. For the most part, each of these separate components are produced by different manufacturers. Therefore, the small-batch manufacturer who wishes to automate must buy various components from various manufacturers and is then faced with the problem of making the various components work together. Some of the more technologically sophisticated companies can do this successfully. However, most small-batch manufacturers lack the required technical capability. This lack of ability to combine automation equipment from different manufacturers is a serious barrier to the adoption of automation by small-batch manufacturers. Each of the above elements and systems must communicate with one another to receive instructions, report progress on the assigned tasks, and report unplanned events events which require remedial action. Each of the many links requires an interface between disparate devices and hence an interface and communication protocol. This program provides the technical basis, required primarily by the voluntary standards community, to design these interfaces, standards, and protocols in such a way as to protect the proprietary interests of the component manufacturers.

Recent accomplishments include: (1) the definition and specification of the NBS protocol to be used in interfacing computer-aided-design systems to computer-aided-inspection systems, connecting for the first time the design and quality control functions in an automated environment; (2) the completion of the installation of a high level language on a microcomputer network demonstrating that the control architecture developed by NBS is realizable on a microcomputer network; and (3) the completion of simulation/emulation of a manufacturing cell to determine the nature of integrated cell interfaces and their data handling requirements. The research performed under this program has also allowed NBS to respond to the needs of other government agencies and the private sector on a reimbursable basis. For example, NBS coordinated a standards writing effort involving over 50 private sector parties which developed the American National Standard Institute's standard for Geometric Data Exchange for computer-aided-design systems. This work, sponsored by DOD and NASA, was undertaken by NBS because NBS was the only neutral party with the necessary expertise. NBS also evaluated proposals for the transferability of the technology and the development of interface standards for the Air Force industrial automation program. NBS was requested to do this work to avoid conflict of interest problems.

Planned accomplishments in fiscal year 1984 include the following:

Develop user interface language needed for programming of sensory interactive tasks for a robot with vision. This will permit any sensory system to be connected to any robot.

Complete and implement a software management program which will assure that all software written during this project is fully transportable so that all interfaces are ready for industry adoption.

Complete all intra-work station interface necessary for independent operation of the NBS Automated Manufacturing Research Facility work stations. This will allow a firm to purchase a complete work station with components coming from different manufacturers.

Complete the development of the generic control processor with cell (two or more work stations) databases and cell command languages to permit initial experiments on cell operation. A cell is required for testing interface standard concepts and theories.

MECHANICAL ENGINEERING METROLOGY $3,271,000

This program carries out scientific and technical activities that provide the measurement methods and standards for the units of length mass, and derived quantities such as force and acceleration which are required, in particular, in automated, manned, or combined man-machine modes of manufacturing. These activities include fundamental research which advances the state-of-the-art of length and force metrology. This program has research activities in many areas, e.g. (1) the use of electron miscroscopy to measure submicrometer dimensions to very high accuracy; (2) the investigation of the basic scientific principles of force measuring transducers; (3) the thermal modeling, dynamic analysis, and modeling to correct for machine errors in three dimensions; (4) the computer analysis of precise images for dimensional inspection; and (5) the investigation of the inverse scattering of optical or acoustical radiation as a means of measuring the dimensions and/or surface finish of machined parts. Another major activity is directed at the development of measurement science, standards, and procedures that will enable the fully automated manufacturing system to make a part whose dimensions are correct to the required accuracy. The metrology developed in this program for the complete automated manufacturing facility is called deterministic metrology. The NBS Automated Manufacturing Research Facility will be the test bed used for the development of deterministic metrology.

The automated manufacturing facility of the future will have the measurement function incorporated in the automated manufacturing process thus eliminating the need for manual or automated measurement of parts during or after production. This advancement shifts the measurement emphasis to the actual manufacturing process for determining that parts will be made to the correct dimensions or shape. In the traditional manual or semi-automatic production environment there exist well-recognized, quality control systems which provide buyer and seller assurance that the products have the correct dimensions. These systems are supported by current NBS calibration programs. The deterministic metrology program will develop new physical standards, procedures, and measurement services to enable small-batch manufacturers to calibrate the machining tools used for product manufacturing to national standards thereby avoiding very costly product inspection operations.

Research conducted in this program has led to a number of recent accomplishments. For example, the installation of the first work station (a machine tool and a robot) in the NBS Automated Manufacturing Research Facility was completed, permitting initial experimentation on the dimensional problems introduced by the use of robots to load machine tools. Measurement capabilities have been extended to account for thermal expansion of machine tools. This extension will allow NBS to develop a measurement capability that will provide the automated shop of the future with means of accessing the national standards of length while bypassing the long warm up procedure now necessary to avoid errors produced by thermal expansion. Research has also resulted in the demonstration of a new surface measurement technique for roughness, extending the technique of on-line surface measurements to the range needed for manufacturing, and in the development of a roughness measurement system of sub-micron resolution providing the first measurement standard in this size range. In addition, because of the technical expertise developed under this program, NBS has been able to provide specialized services to other Government agencies and the private sector on a reimbursable basis. For instance, NBS has performed calibrations for length, mass, and derived quantities and special tests for over 200 companies and 25 Federal and State agencies. NBS has also developed special metrological tools for DOE to permit characterization of a lathe capable of producing optical surfaces vital to DOE's fusion project. NBS was requested to do this work in order to establish traceability of measurements to National standards.

Planned accomplishments in fiscal year 1984 include the following:

> With the completion of the installation of the NBS Automated Manufacturing Research Facility, extend the concepts of deterministic metrology developed for the process of milling to other operations such as the operation of a lathe. This provides traceability to the national standards of length without having to have a separate and costly post-production inspection operation.
>
> Test full adaptive control using deterministic metrology for high accuracy contour milling, thereby proving that this measurement concept can be implemented on the most difficult machining process.
>
> Issue surface roughness artifacts covering the range of roughness with vertical dimensions down to 20 nanometers and in various lateral dimensions completing the new set of industrially important roughness standards. This is a measurement service which has been repeatedly requested for use in such areas as determining the surface quality of laser mirrors, the friction of moving parts, and the appearance of paint on surfaces.
>
> Validate an on-line roughness measuring system to prove feasibility of deterministic metrology for an important characteristic.

ROBOTICS RESEARCH AND DEVELOPMENT.. $3,500,000

Robotics is a field of technology which is of growing importance to the productivity advancement of manufacturing technology in the U.S. It is also a field where some foreign countries, such as Japan, are technologically ahead of the U.S., and where foreign competition therefore is strong. Advances in the state of the art within the U.S. robotics industry can be materially aided by NBS's development of generally applicable techniques, concepts and standards.

Before robots can make further contributions to productivity improvement they must not only be much more widely used throughout industry, their ability to perform a much wider range of tasks must be improved significantly. The great majority of industrial tasks are currently beyond the capacities of present-day robot technology. Most industrial tasks now performed by humans are too complex or unstructured, or involve too many uncertainties, or require too much ability to see and feel and adapt to changing circumstances to be performed by robots. Although robots now are increasingly used in such operations as spray painting and arc welding, where the positioning of the tools is relatively simple, they are not yet able to perform such tasks as parts assembly. If robots are to perform such more complex tasks, they must be able to execute complex tasks with much greater dexterity, speed and flexibility than they are capable of now.

The Bureau currently has a modest effort in robotics research which is focused on performance measures, programming language standards, better visual and tactile sensors, and hierarchical control strategies. The strengthened program in fiscal year 1984 will build on that existing effort.

The objectives of this program during fiscal year 1984 will be:

Continue research and development on sensors needed for robots to see, feel, and determine position of objects.

Improve robot positioning ability in order to permit robots to pick up and deposit an object at a mathematically defined point in space with greater accuracy.

Continue research on control algorithms needed to permit robots to have increased flexibility.

Continue research on robot mobility, including the establishment of the requirements and the mechanical, sensor and logic feasibility.

AUTOMATED MANUFACTURING RESEARCH FACILITY	$1,559,000

This program provides the capital for the various machine tools, robots, controls, etc., necessary for the development of the Automated Manufacturing Research Facility (AMRF) required by the Robotics R&D program and the two associated programs, Automated Manufacturing Interface Standards and Mechanical Engineering Metrology. While the AMRF will resemble a flexible manufacturing system, the facility is not designed to be a production facility. Instead it is designed to present a variety of interfacing problems relevant to flexible manufacturing systems. The AMRF will include a number of robotic systems; in fact, the facility as a whole can be considered as a very sophisticated robot. Consequently, the facility will enable the investigation of the applicability of hierarchical control systems or modularity concepts for flexible manufacturing systems or robotic systems. In addition, it will allow the associated programs to address interface and metrology problems relative to robots.

Recent accomplishments in this program include: (1) completion of advanced simulation/emulation experiments to determine necessary characteristics and specifications for a control computer using NBS easy interface control architecture; and (2) completion of robot specifications necessary to interface with control hierarchy for two work stations.

In fiscal year 1984, the program's main accomplishment will be to finish the procurement of components, e.g. a material handling system, controls, and robots necessary to complete the assembly of the Automated Manufacturing Research Facility.

5. TECHNICAL COMPETENCE FUND	**$7,672,000**

This program was established to ensure NBS' technical expertise and to maintain the capacity to contribute effectively to future national needs and goals. The ability of NBS to respond to directly mandated responsiblities and needs of other Federal agencies arises from the basic technical competence of the NBS staff and a carefully planned program of long-term research. The most important impact of the competence building effort is technology and information transfer from the competence areas to the problem solving areas of NBS and the user community.

The selection of specific competence projects is based on the following criteria: long-range public and economic benefit; scientific and technical merit; match to NBS mission objectives; and potential for transferring outputs to NBS program areas and clientele. After identifying the scientific and technical areas where competence building efforts are needed, the critical size of these efforts and the desirable rate of development are determined and used to estimate the required resources in personnel, equipment, and operating funds. Priorities are determined considering the needs established in the initial assessment process, the impact on industry and society, scientific opportunity, and other factors. Resources are then allocated to competence efforts in order of priority. Adjustments of funding for specific projects are made depending on changing needs, rate of progress, and technical opportunities.

Some examples of the projects funded to date in the competence program include research in surface science, picosecond laser chemistry, ionizing radiation effects, quantum radiometry, compositional mapping, wave optics for metrology, compound semiconductors, gigabit electronics, and protein stabilization. Research conducted in this program has led to a number of recent accomplishments. One example is the use of pulsed radiolysis techniques to determine the mechanism for free radical-induced changes in the structure of peptides. This work advances the understanding of chemical interceptors which lessen radiation damage and has significant applications in food irradiation processing. Another accomplishment has been the demonstration of a new electrical technique (photo excited deep level transient spectroscopy) for characterizing the purity and quality of semiconductor substrates used in the manufacture of high-speed electronic devices. This technique circumvents measurement problems usually associated with these semi-insulating materials. In addition, a high temperature, high pressure, experimental phase equilibria apparatus has been developed for determination of vapor-liquid equilibria and liquid-liquid equilibria of complex fluid mixtures used in industrial chemical processes. A small-angle-neutron-scattering technique with unique capability for measuring the effects of deformation on the microstructure of high strength steels has also been developed. This technique will provide insight into the role of precipitates in determining the properties of these steels. Semiconductor photodiodes have also been devloped to improve the accuracy of measurements with near infrard detectors for remote sensing, military weapons development, and research in optical communications.

Planned accomplishments in fiscal year 1984 include the following:

Develop techniques to determine morphology, chemical and isotopic composition, and crystal structure of individual submicrometer sized particles. Such information is useful in understanding the behavior of small particles in physical, biological, and technological processes.

Determine the vibrational spectra of hydrogen-containing molecules on high-area catalyst materials by the novel method of neutron inelastic scattering. This will allow identification of the reaction pathways of prototype catalytic reactions.

Analyze and calibrate the degree of separation of charged proteins in a polyacrylamide gel matrix. This is a necessary prerequisite to achieving an accurate separation system for complex biomolecules.

Develop a capability for fabricating Josephson "edge" junctions. These very small junctions are required for identification of the limits of speed of digital measuring and signal processing circuits based on Josephson-junction technology.

Formulate and provide a model for transient heat transfer between binary fluid mixtures and solid bodies in transient thermal processes of emerging industrial importance. This will provide a foundation for optimization of a new class of industrial heat transfer processes.

6. CENTER FOR FIRE RESEARCH (Sec. 101(a)(6))........................ $6,386,000

This program provides the scientific and technical basis to reduce the Nation's fire losses and the cost of fire protection. The program's strategy is to develop the technical basis for fire hazard assessment in order to provide the fire community with new and improved practices for reducing fire hazards. Program activities include research on: ignition and fire spread and the determination of their role in smoke and toxic gas evolution; the development of physical and chemical models for smoldering fires; the fundamental mechanisms of fire extinguishment; the fire properties of materials; the relationship between fuel characteristics and flame spread; the correlation between fire behavior in small and full-scale fires; and predictive mathematical models of the time evolution of fire hazards. These activities produce test methods, proposed standards, and recommended practices for use by design professionals, code officials, product developers and for the training of fire service personnel. In addition, as an integral part of the program, $2 million is provided annually to about 30 universities and organizations for fundamental fire research. These grants currently represent the only funding source for research through which our Nation's new fire scientists are trained.

Research conducted in this program has led to a number of recent accomplishments. For instance, a bench-scale test method for measuring the rate of heat release from the burning of pure and composite materials has been completed. The rate at which burning materials release heat is a prime factor in determining the time span in which a room fire reaches its most deadly state and the time available for escape, rescue, or extinguishment. Work has also been completed on a standard room fire test for interior finish materials. The standard test will provide a reproducible means for the validation of predictive models of fire spread and a common base for laboratories (e.g. insurance, manufacturing, and universities) that evaluate materials performance. This program is also responsible for the development of a quantitative building fire safety evaluation model to augment the intuitive approaches currently used. The model will improve the basis for decisions on cost effective fire interventions and human escape strategies. In addition, the expertise developed under this program has enabled NBS to respond to special requests from other Government agencies and the private sector on a reimbursable basis. For instance, for the Department of Health and Human Services NBS developed a Fire Safety Evaluation System that relates the safety of board and care homes to the capabilities of their residents. This system will be used by state and local governments to develop cost-effective regulations. This is especially important in providing rational, economic trade-offs in retrofitting existing facilities to meet code requirements. A similar system developed for hospitals has saved the U.S. public millions of dollars without increasing the fire hazards to building occupants. For the Federal Aviation Administration, NBS produced a model and method to assess the fire risk reduction achievable in passenger aircraft for various options, such as the use of flame retardant seat materials. NBS provided DOE and the Consumer Product Safety Commission with the technical basis for code changes to reduce the significant increase in residential fires caused by wood-burning stoves and heating appliances. These and other agencies came to NBS because of the unique capabilities of the NBS Center for Fire Research.

Planned accomplishments in fiscal year 1984 include the following:

Measure the penetration of water droplets into large flames which will provide the basic data to model the dilution effects of water on flames.

Develop a conceptual framework for risk assessment methodology which draws on risk estimation techniques of statistical inference, modeling and subjective estimation. Regulatory officials, policy makers, and fire safety officials require quantitative means to measure and manage fire risk to people and property.

Propose a test method for measuring flame spread over horizontal surfaces. Flame propagation over floors or furnishings is a major contributor rapid growth.

Create a physical model explaining the transition from smoldering to flaming combustion. Over one quarter of all fire deaths result from fires that begin as smoldering.

7. CENTRAL TECHNICAL SUPPORT (Sec. 101(a)(7))........................ **$10,659,000**

The goals of this activity can be grouped into six areas: (1) *Central Planning*—provide the NBS management a planning framework in the context of a long-term mission and philosophy, which establishes an understanding of the appropriate NBS contributions to national objectives and the specific needs of the users of NBS outputs; (2) *Research Associate Programs*—provide scientists and engineers from industry, academia, and other Federal agencies who demonstrate outstanding promise and ability an opportunity to participate in research programs in the various branches of physical, engineering and mathematical sciences; (3) *Computing Support*—provide computer support which responds to evolving scientific and engineering demands, and which provides the modern computational facilities required by NBS scientists, engineers and administration to achieve the major mission goals of NBS; (4) Facilities Modifications and Improvements; and (5) Transfers to the Working Capital Fund.

CENTRAL PLANNING $400,000

This program was established in fiscal year 1979 to assess NBS research priorities and to evaluate NBS long-range opportunities that respond to national needs. Studies are carried out to determine the impact of NBS activities and to analyze the needs of users in both the public and private sectors. Through direction and example, this program assists NBS operating units to incorporate the concepts of economic benefits, impact analyses, and explicit priority setting into their own program planning evaluations. In addition, this program has contributed directly to policy decisions within the Department concerning technological and industrial productivity. A major activity of this program is the preparation of a long-range plan for NBS, which focuses on strategic issues and program thrusts.

Recent accomplishments include two studies which assessed the potential impact of NBS research in the area of manufacturing automation and biotechnology; revision of a long-range plan for NBS focusing on strategic issues and program thrusts and incorporating the results from studies and other planning activities; and the evaluation of the economic and social benefits of NBS programs to develop an understanding of the relationships among NBS programs, technological development, and the achievement of national goals with a view to strengthening the Bureau's contributions and establishing program priorities.

Planned accomplishments in fiscal year 1984 include the following:

Complete technological and economic assessments of future developments in advanced ceramic materials and possible impact upon NBS.

Continue analytical effort toward measuring the economic impact of NBS programs to assist NBS managers in establishing priorities for selecting research areas.

RESEARCH ASSOCIATE PROGRAM $2,637,000

This program consists of the Industrial Research Associate program, the Postdoctoral Research Associate program, and the Graduate Cooperative Education program. These components have the direct effect of maintaining NBS competence by making available each year more than 150 high caliber scientists for ongoing research programs and providing a mechanism for technology transfer of NBS research and methods to the scientific and engineering communities. The Research Associate program serves as an excellent information exchange system and recruitment vehicle.

The Industrial Research Associate program enables scientists and engineers from industrial, professional, trade, and other organizations to work at NBS under the sponsorship of their employers who cover all personal expenses. These research associates contribute their special expertise, working with NBS staff on projects of clear mutual interest. In addition to providing an effective means of information exchange this program also makes available to the private sector the excellent, and often unique, research facilities which exist in Government laboratories. Participants in the Postdoctoral Research Associate program are scientists and engineers who have recently earned their doctorate degree and have demonstrated superior ability for creative research. The prospective candidates are evaluated by the National Academy of Sciences/National Research Council. Associateships are awarded for work at NBS in the various branches of the physical, engineering, and mathematical sciences. Their significant contributions to ongoing research programs at the Bureau often result in their becoming permanent employees of NBS. Through the Graduate Cooperative Education program, students are appointed to work at NBS to enhance ongoing research programs. Many of these students are hired by NBS upon completion of their graduate work. Both the Postdoctoral Research Associate and Graduate Cooperative Education programs are fully supported by appropriated funds.

Recent accomplishments by the group of postdoctoral associates include the following:

Establish relationships between stress and loading at various locations on a square glass plate. This is an important step in the development of a model that will predict the probability of breakage of a glass panel subjected to wind loads.

Develop an improved photoluminescence measurement capability for NBS which will be used for advanced research measurements of semiconductor surface impurities, critical to integrated-circuit performance.

Extend advanced mathematical methods to critical testing of digital circuits such as tests for cross-wire and other faults which could not previously be isolated. This is an important step in developing the fundamental mathematics needed for the testing of complex electronic systems.

Determine thermochemical effects on microstructures and dielectric properties of zirconium titanate based ceramics, necessary for the design of advanced microwave devices.

Develop techniques for decelerating a beam of neutral atoms using a carefully polarized laser beam and a special configuration of magnetic fields. Very slow or "cold" atoms can be used to reduce limitations on high precision spectroscopy and to reduce the errors in atomic clocks.

COMPUTING SUPPORT $1,730,000

This program provides central computing facilities for all NBS programs. Acquisition of a replacement scientific computing system was begun in fiscal year 1982. Following a General Accounting Office study requested by the House Government Operations Committee the Deputy Secretary of Commerce called for a study of NBS and National Oceanic and Atmospheric Administration central computing requirements. This study is to be completed by December 31, 1982 and will be a determining factor in the decision to complete the NBS central system or provide a consolidated system for NBS and NOAA. NBS has installed a limited capability upgrade of its obsolete central computing system which will improve computing capabilities at NBS until the new replacement system becomes operational. In fiscal year 1983, this program has continued to acquire external computing capability to provide computing services to all scientific programs at NBS through an appropriate combination of lease and purchase.

Improved computing will more effectively support NBS scientists in such tasks as analyzing and reducing experimental data, and preparing and disseminating the results of research. A modern system facility will have the following benefits:

Encourage replacement of time-consuming and expensive experiments by analysis of appropriate models.

Reduce nonproductive time spent by scientists and engineers in seeking sources of computer service and in waiting for the results of computer runs.

Make possible much more rapid organization and search of stored data and timely preparation of reports for general dissemination or responses to individual requests for information.

Allow for closer coordination with up-to-date information systems in use in industry, commerce, other Government agencies, and research institutions.

FACILITIES MODIFICATIONS AND IMPROVEMENTS $641,000

As the National Bureau of Standards facilities in Gaithersburg, Maryland, (17 years old) and Boulder, Colorado, (27 years old) continue to deteriorate, the need for improvements, modifications, and repair or replacement becomes a bigger problem. On occasion, extraordinary repairs are necessary on an emergency basis to restore equipment failures and/or facilities damaged by natural causes. The program to systematically replace aging and obsolete facilities and equipment is continuing. Technical surveys and studies have been conducted to identify cost-effective energy conservation retrofit projects which should be accomplished in fiscal years 1984 and 1985.

Planned accomplishments in fiscal year 1984 include the following:

Maintain the plant facilities and equipment at a level responsive to NBS programs.

Continue replacing facilities and equipment in order to avoid excessive maintenance costs.

Implement cost-effective energy conservation measures to meet regulatory and legislative requirements.

TRANSFERS TO THE WORKING CAPITAL FUND $5,251,000

The funding level of $5,251,000 in fiscal year 1984 will permit NBS to (1) finance $2,897,000 to recover the replacement value of the NBS depreciable equipment inventory that has been eroded by inflation, (2) provide $870,000 for capitalization of SRM research and development costs, and (3) provide $1,484,000 to assist in SRM inventory replenishment.

The operations of the Working Capital Fund—which encompass all NBS activities except gifts and bequests and the Foreign Currency Program—are reported in a program and financing schedule printed in the President's budget, as well as reflected in the reimbursable amounts throughout this budget. The funds finances the initial cost of work performed by the Bureau and is reimbursed by applicable appropriations and advances or reimbursements from other agencies. A detailed cost accounting system is used to insure that the actual cost of work performed for each job or task is recorded and identified with the appropriate source of financing. In addition to its function as a revolving fund, the Working Capital Fund is also used to handle annual and sick leave on an accrued basis, to acquire equipment as an investment to be recovered through depreciation charges to programs, to distribute indirect costs to programs as overhead, to carry the recoverable costs associated with the production of Standard Reference Materials, and to carry supply inventories until issued for program use.

The Working Capital Fund provides for several types of asset investments:

1. General equipment—Investment in equipment having general utility and a relatively long-term useful life. Reimbursement is affected by depreciation charged over the period of useful life to benefiting projects.
2. Standard Reference Materials—Investment in production, analysis, and packaging of a large variety of materials that are certified as to physical characteristics or composition. The fund is reimbursed when the Standard Reference Materials are sold.
3. Supplies—Bureau storerooms carry an inventory of about 11,000 different items of electrical, electronic, chemical, and hardware supplies and materials. These are carried as inventory assets of the Working Capital Fund until they are issued to benefiting projects.

In addition to the cash needed for the foregoing investments, cash is required to cover daily accounts receivable, accounts payable, reserve for leave, and other current assets and liabilities. Management determinations of the amount of equipment, inventory, or Standard Reference Materials investment that can be permitted must, therefore, take into account the available capital, the rapidity of replenishment of the invested capital, and cash needed for current operations.

The total capital of the Working Capital Fund on September 30, 1982 was $164.4 million. This capital is made up of the original appropriations for the Fund ($5,000,000); payments and transfers totaling $41.1 million to the Fund from other Bureau appropriations; the value of lands and buildings picked up as donations to the Fund at its inception and later; the undepreciated value of general equipment donated to the Fund at its inception; the value of non-depreciable equipment donated to the Fund; and the value of other donated assets, such as precious stones, the initial storeroom inventory, and the initial Standard Reference Material inventory.

When one is examining the status of the Working Capital Fund for purposes of reviewing the resources available for operations or investments, it is important to recognize that the capital of the Fund consists of more than the original $5,000,000 appropriation. Conversely, not all of the recorded capital of $164.4 million is available for operations or investment. That portion of the total capital that was derived by donation of lands, buildings, precious stones, and non-depreciable equipment cannot be turned into cash through depreciation charges or sales and therefore cannot become available for reinvestment or operating capital. The following table summarizes the total capital by sources, indicating which is available for operations and investment.

OFFICE OF PRODUCTIVITY, TECHNOLOGY AND INNOVATION

(Sec. 104)	$3,752,000

The goal of the Office of Productivity, Technology and Innovation is to stimulate U.S. private sector productivity, international competitiveness, and economic growth by: identifying, analyzing, and seeking the removal of barriers to productivity by developing new policies or other appropriate actions; facilitating private joint research arrangements to achieve major advances in technology; disseminating productivity know-how to business; coordinating Federal patent policy to increase the comercialization of innovations; and promoting voluntary private sector conversion to the metric system.

PRODUCTIVITY ENHANCEMENT	$1,030,000

The objective of this program is to identify and analyze factors impeding productivity growth, to develop long-term policy options for mitigating or eliminating them, and to recommend actions producing an economic climate conducive to productivity enhancement. Policy studies are produced to encourage public or private mechanisms for enhancing productivity, and for rendering information and technical assistance to business and state and local government.

Examples of specific work include the following:

Examining the relative contributions to productivity growth (or decline) of such factors as capital, energy, Government regulation, human resources, measurement, etc., and recommending appropriate actions to produce positive results for each;

Providing basic information, analyses, or option papers on request to policy-level officials, cabinet committees (Cabinet Council on Economic Affairs, Cabinet Council on Commerce and Trade), or special organizations (e.g. National Productivity Advisory Committee and the White House Conference on Productivity);

Maintaining contact with and providing representations to domestic and international productivity organizations (e.g. the American Productivity Center, the European Association of National Productivity Centers, and the Japan Productivity Center) to ensure ready access to the latest state-of-the-art knowledge, for integration into policy papers or for responses to information requests.

Operating a measurement program designed to promote the use of firm-level productivity measurement, to contribute to the improvement of Federal productivity data/statistical analysis, and to seek the utilization of multi-factor productivity measures at all levels of the public and private sector.

Administering a Productivity Steering Group as the principal mechanism for coordinating DOC strategic planning, productivity information exchange, data collection, research, and contact with the National Productivity Advisory Committee, Cabinet Council on Economic Affairs, the Congress and the private sector.

Information and outreach—Through a national clearinghouse/resource center, information on productivity improvement methods is collected and disseminated upon request (or through workshops and seminars) to provide U.S. firms and business organizations with tested practical tools for enhancing productivity. GAO, private sector productivity centers, and industry have identified this function as an essential Government responsibility (i.e., one which does not compete with private information activities) needed especially by small- and medium-sized firms.

Research and information —OPTI handles the numerous requirements contained in Section 5c of the Stevenson/Wydler Technology Innovation Act for studies, assessments, policy experiments, etc. involving the relationship of technology and the U.S. economy (e.g., employment, trade, and capital formation).

COORDINATION OF FEDERAL PATENT POLICY $484,000

This program coordinates and monitors Federal technology transfer and patent policy including promotion of private sector opportunities for commercializing inventions resulting from projects financed with Federal Government funds. The Patent and Trademark Amendments Act of 1980 (P.L. 96–517) included provisions to give small business, and non-profit organizations, and universities first right of refusal to title to inventions made with Government funding. To the degree allowed by statute, the right of contractor ownership was extended to nearly all Federally funded R&D performers by a Presidential Memorandum on February 18, 1983.

In addition, Government agencies are encouraged to grant exclusive licenses for Government-owned inventions. Federal patent policy is an element of technology transfer and has a relationship to the Stevenson-Wydler Technology Innovation Act (Pub. L. 96–480). This progam provides a centralized focus for oversight and evaluation of the implementation of the new patent policy and the response of the private sector to the new policy.

This program performs the following functions:

Assists the Executive Office of the President and affected Federal agencies in developing the statutory and administrative procedures necessary to establish and monitor a uniform patent policy, and undertake the management, oversight, and evaluation of this policy to assure its effectiveness.

Develops systems for use by all Federal agencies to identify inventions with significant commercial potential, increase the commercialization of these inventions, reduce the costs of protecting the Government's interest and provide incentives for Federal employee inventions.

Coordinates the establishment of uniform invention report forms, utilization report forms, criteria for filing patent applications on Government-owned inventions, and standards for disposition of Government-employee inventions. In the absence of uniform Government-wide standards, agency management of patents has been uneven. Sound criteria for filing patent applications on Government-owned inventions and a uniform invention report form will reduce public paperwork and regulatory burdens.

Evaluates the effectivenss of the Patent and Trademark Amendments Act and executive Office procedures and, in coordination with other agencies, makes recommendations for legislative or regulatory changes, as appropriate.

Convenes conferences and workshops to assist Federal agencies, businesses, and universities to implement the new Federal patent and technology management policy. Such workshops would have as a primary objective the provision of information on how to get access to patent rights on Federally-funded inventions and on Federal policies regarding the commercialization of those inventions.

Chairs a Federal agency committee to provide information and guidance to assist the Department in performing its Federal patent policy functions.

Coordinates administration positions on proposed legislation related to technology management and ownership of inventions made with Government support. This function would be supported by the Department's data base on agency implementation of Federal patent policy and its chairmanship of the committee cited above.

Monitors the Federal patent policy and procedures of other key trading partners and the rights of U.S. companies in acquiring patents owned by foreign governments.

Monitors related technology transfer functions of Federal agencies as such agencies seek to diffuse their technology to U.S. industry by means other than through patent rights including participation in Industrial Technology Limited Partnerships.

CONVERSION TO THE METRIC SYSTEM $362,000

This program administers those Federal functions and responsibilities related to producing an environment favorable to the voluntary conversion to the metric system in the United States. This Office has been in existence since October, 1982, at which time the Department of Commerce was given the responsibility for removing the barriers to voluntary conversion. A Plan of Action for meeting this goal has been developed.

One of the main missions of the Department of Commerce is to promote U.S. exports to expand our share of the international marketplace and improve our trade balance. To compete effectively in foreign markets, the U.S. must consider producing metric products. The U.S. is one of only five countries (Brunei, Burma, North and South Yemen are the others) which have not announced plans to convert to predominant or exclusive use of the metric system.

This Office performs those activities which are crucial to providing the private sector with a clear message that use of the metric system is to be encouraged and to lay the groundwork for the time when the U.S. will be predominately metric. The Office works with industrial and business organizations, other Federal agencies, and state and local governments to develop a cooperative program that will facilitate planning for metric conversion. Much of the interaction with the private sector is coordinated through the American National Metric Council. At the request of the Council, the Department of Commerce cosponsored their 9th Annual Conference.

The Office provides information regarding metric laws and practices in international trade both directly and with the assistance of offices of the International Trade Administration.

Coordinating the Federal government's own metric conversion activities is an important continuing role of this Office. A new charter for the Interagency Committee on Metric Policy was issued by the Secretary of Commerce on March 28, 1983. The experience of the Defense Department has shown that the absence of metric procurement standards is a barrier to conversion within the DoD necessary for interoperability of equipment with allied countries. Therefore, a policy is being developed that all Federal standardization documents that are measurement sensitive be also available in metric designations. The Office will be working with the General Services Administration and private sector standards organizations to assure that such metric standards are available by the end of the five year review cycle for updating Federal standardization documents. The Office will work with the private sector in supporting the development and operation of a log of metric standards. The Office also publishes the Federal Metric Status Report and the Federal Metric Information Referral Directory.

The Office also uses the National Council on State Metrication and the National Conference on Weights and Measures as two-way information exchange mechanisms.

The Office is responsive to requests for interviews and information from the news media and for information from the general public. Approximately 200 general information inquiries are received each week with an additional 25 requesting specific information. Publication of articles for the trade press on metric conversion is underway and numerous talks to industrial associations have been presented. The presence of single Federal focus for metric activities will help assure that the transition to the metric system occurs as efficiently as possible in a coordinated and coherent manner.

PATENT LICENSING PROGRAM	$876,000

This program seeks to improve productivity and encourage innovation in the domestic economy through the licensing of U.S. Government invention technology. It also seeks to bring selected inventions to the attention of U.S. industry through direct industry contacts and specialized marketing strategies, prevent unrestricted, uncompensated foreign use of U.S. Government invention technology, and protect important foreign markets for U.S. trade and development by the filing of foreign patent applications on selected inventions. This program provides the mechanism for greater utilization of the many inventions to which the Government has title and are available for licensing.

INDUSTRIAL TECHNOLOGY PARTNERSHIPS/CENTER FOR THE UTILIZATION OF FEDERAL TECHNOLOGY	$1,000,000

OPTI works with the private sector, universities, research institutes, and state and local governments to encourage the formation of joint R&D ventures of various types. This includes the formation of research and development limited partnerships (RDLP's) as a means of commercializing new products and processes.

These ventures, which involve tax incentives, can contribute to stengthening the technological competitiveness of U.S. industry vis-a-vis foreign targeted industry strategies. RDLP's can increase the pool of capital available for R&D, finance the commercialization of federally owned or developed technology, shorten the development time of new technologies, and help integrate institutions and disciplines into a coherent technology development program.

OPTI's program in this area (the Industrial Technology Partnership Program) clarifies the application of tax and antitrust laws through the development and dissemination of guidelines, seeks changes to these laws where necessary to facilitate the formation of RDLP's and cooperative R&D projects, and trains potential general partners about the RDLP concept, Administration policy, and the availability of related government programs (such as patent licensing and the Center for the Utilization of Federal Technology). In addition, OPTI operates a research associates program by which business persons (and others) can spend up to a week or more with OPTI; convenes workshops or meetings on behalf of a General Partner; works with universities or local governments in an effort to help them identify potential roles in RDLP's (which can also serve to augment the transfer and commercialization of Federally-funded technology); and develops data bases for RDLP-candidate projects identified by the private sector. Further, there is an extensive outreach effort to inform the business and research community of the advantages of RDLP's. Additional activities for fiscal year 1984 include networking/referral services for small business such as invention evaluation, government programs, and sources of engineering services.

As part of the ITP Program, OPTI is supporting the Center for the Utilization of Federal Technology (CUFT), established by the Stevenson-Wydler Technology Innovation Act of 1980. CUFT, which is located at, and is directly managed by, NTIS, monitors the technology transfer activities of Federal laboratories and disseminates technical information generated by them.

CUFT coordinates with technology transfer offices in other Federal laboratories, prepares a report to the Congress and President concerning the activities of Federal agencies under the Stevenson-Wydler Act, develops and maintains a Government-wide directory of Federal technology transfer activities and acts as a resource aid for the Industrial Technology Partnership Program by providing technical data base searches and other services.

NATIONAL TECHNICAL INFORMATION SERVICE

Sec. 105	**$175,000**

In recent years, Japan has made significant strides in the advancement of its scientific research and technology development activities. In some areas Japan has caught up with the state of the art in the United States, and in a limited number of fields, it has moved ahead of the United States.

It is therefore timely that a concerted effort should be made to make the research papers and technical reports covering the important advances in science and technology in Japan available to American scientists and engineers. The post World War II flow of such papers and reports from the United States to Japan should now effectively be matched by a comparable flow in the opposite direction.

For this purpose the sum of $175,000 would be authorized to the Assistant Secretary of Commerce for Productivity, Technology and Innovation for use by the National Technical Information Service to make Japanese science and engineering literature available in the United States in English translation.

6. SECTIONAL ANALYSIS OF THE BILL

H.R. 2513

A bill to authorize appropriations to the Secretary of Commerce for the programs of the National Bureau of Standards for fiscal year 1984, and for other purposes. This Act may be cited as the "National Bureau of Standards Authorization Act for Fiscal Year 1984".

SECTION 101

This section authorizes appropriations to the National Bureau of Standards for fiscal year 1984 in the amount of $125,485,000. The budget activities are authorized as follows:

(1) Measurement Research and Standards, $52,031,000.
(2) Engineering Measurements and Standards, $22,881,000.
(3) Computer Science and Technology, $11,500,000.
(4) Core Research Program for Innovation and Productivity, $14,356,000.
(5) Technical Competence Fund, $7,672,000.
(6) Fire Research Center, $6,386,000.
(7) Central Technical Support, $10,659,000.

This section also provides that, of the funds authorized for Engineering Measurements and Standards, not less than $4,509,000 shall be available for the Center for Building Research.

This section also provides that, of the funds authorized for Measurement Research and Standards and Engineering Measurements and Standards, not less than $1,000,000 shall be available for Measurement Standards for the Handicapped.

This section also provides that, of the funds authorized for Computer Science and Technology, not less than $10,500,000 shall be available for Computer Science and Technology.

This section also provides that, of the funds authorized for the Core Research Program for Innovation and Productivity, not less than $3,500,000 shall be available for Robotics Research and Development.

This section also provides that, of the funds authorized for the Fire Research Center, not less than $6,386,000 shall be available for the Fire Research Center.

This section also provides that, of the funds authorized for Central Technical Support, not less than $400,000 shall be available for Central Planning Office.

SECTION 102

This section authorizes $700,000 in excess foreign currencies for expenses of the Bureau incurred outside the United States.

SECTION 103

This section amends section 12(f) of the Organic Act (15 U.S.C., 278b(f)) to allow net income to be used to replace equipment and inventories before the net sales proceeds are paid into the general fund of the Treasury. This section also authorizes NBS to increase and retain fees for calibration services, standard reference materials and other comparable services in order to recover not only operating costs but also a part of the R&D costs. Such increases must be returned to the Treasury to offset the appropriated funds that would be included for the R&D costs.

SECTION 104

This section authorizes $3,752,000 in funds to be appropriated for activities in the field of innovation and productivity by the Office of Productivity, Technology and Innovation.

SECTION 105

This section provides that the National Technical Information Service shall make Japanese science and technology literature available in the United States, and would authorize $175,000 for this purpose.

SECTION 106

This section authorizes salary adjustments and provides for salary adjustments to be made proportionally from line items in section 101(a), and in section 104, if funds are not appropriated for salary adjustments.

SECTION 107

This section provides that funds appropriated pursuant to this Act shall remain available for expenditure and obligation according to such provisions as the appropriations act may specify.

SECTION 108

This section provides that funds may be transferred into, or out of any line item in section 101(a) provided that if the Bureau wishes to transfer sums in excess of 10 percent, notification must first be given to the appropriate House and Senate Committees, and then a thirty-day waiting period must be observed unless each Committee agrees to the action prior to that time.

SECTION 109

This section requires the Secretary of Commerce to charge for services rendered by the Bureau to other Government agencies or in compliance with any statute unless funds are specifically appropriated for that purpose, or the costs are nominal.

7. OVERSIGHT ACTIVITIES

Pursuant to Rule XI, Clause 2(1)(3)(A), and under the authority of Rule X, Clause 2(b)(1) and Clause 3(f), of the Rules of the House of Representatives, the following statement on oversight activities is made.

Committee oversight of the National Bureau of Standards from May 1982 through April 1983 has consisted principally of hearings, inspection of the NBS facility at Gaithersburg, Md., staff attendance at NBS meetings, and informal discussion between Committee Members and staff and NBS representatives.

The Committee's oversight findings and recommendations are contained in the body of this report.

Hearings

Testimony was given by NBS witnesses and others appearing at NBS Fiscal Year 1984 Authorization hearings on March 22 and 23, 1983.

Inspection of NBS Facility at Gaithersburg, Md.

On February 14, 1983, Members and staff of the Committee visited the research facilities in Gaithersburg, Md. for the purpose of program and facility familiarization.

Attendance at NBS Meetings

Members of the Committee and staff have met with NBS staff to receive various briefings on budget and program matters.

Plans

During the coming year the Committee plans for oversight include review of selected programs and projects of the NBS.

8. OVERSIGHT FINDINGS AND RECOMMENDATIONS BY THE COMMITTEE ON GOVERNMENT OPERATIONS

Pursuant to Rule X, Clause 2(b)(2) and Rule XI, Clause 2(1)(3)(D) of the Rules of the House of Representatives, the following oversight findings and recommendations made by the Committee on Government Operations have been received: No statement of findings and recommendations was received as of the date of this report.

9. CONGRESSIONAL BUDGET ACT INFORMATION

This bill provides for new authorization rather than new budget authority and consequently the provisions of section 308(a) of the Congressional Budget Act of 1974 are not applicable. No authorization for State or local financial assistance is included in the bill.

10. COST ESTIMATE, CONGRESSIONAL BUDGET OFFICE

U.S. Congress,
Congressional Budget Office,
Washington, D.C. April 25, 1983.

Hon. Don Fuqua,
Chairman, Committee on Science and Technology, House of Representative, Rayburn House Office Building, Washington, D.C.

Dear Mr. Chairman: Pursuant to Section 403 of the Congressional Budget Act of 1974, the Congressional Budget Office has prepared the attached cost estimate for H.R. 2513, the National Bureau of Standards Authorization Act for Fiscal Year 1984.

Should the Committee so desire, we would be pleased to provide further details on this estimate.

Sincerely,

Alice M. Rivlin,
Director.

Congressional Budget Office—Cost Estimate

1. Bill number: H.R. 2513.

2. Bill title: National Bureau of Standards Authorization Act for Fiscal Year 1984.

3. Bill status: As ordered reported by the House Committee on Science and Technology, April 19, 1983.

4. Bill purpose: H.R. 2513 authorizes the appropriation of $125.5 million, plus such additional sums as may be necessary for adjustments in salary, pay, retirement and other employee benefits, for the National Bureau of Standards (NBS) in fiscal year 1984. In addition, $3.8 million is authorized to be appropriated in fiscal year 1984 for the Office of Productivity, Technology and Innovation (OPTI), $0.7 million for use of excess foreign currency, and $0.2 million for the National Technical Information Service. The bill would also allow NBS to adjust fees for certain goods and services to cover estimated replacement costs.

Fiscal year 1983 appropriations to date for the activities authorized by the bill are $124.1 million. The President's 1984 budget requests $103.2 million for these programs.

5. Estimated cost to the Federal Government:

[By fiscal years, in millions of dollars]

	1984	1985	1986	1987	1988
Authorization level:					
Specified (Function 370)	130.1				
Estimated (Function 920)	4.2				
Total	134.3				
Estimated outlays:					
Function 370	86.8	39.2	4.1		
Function 920	3.8	0.4			
Total	90.6	39.6	4.1		

H.R. 2513 would allow the NBS to increase fees for certain services to recover a portion of the costs of research and development, in addition to the current charges which cover only operating costs. According to NBS, additional fee collections of approximately $0.5 million annually could be collected as a result of this provision.

Basis of estimate: For purposes of this estimate, it was assumed that the amounts authorized in the bill for 1984 would be appropriated prior to the beginning of the fiscal year. In addition, authorization for pay and other benefits increases of approximately $4.2 million were estimated based on CBO's baseline projections. Outlays reflect historical spending patterns.

6. Estimated cost to State and local governments: None.

7. Estimate comparison: None.

8. Previous CBO estimate: On March 24, 1983, the CBO prepared a cost estimate for S. 821, as ordered reprted by the Senate Committee on Commerce, Science and Transportation, March 22, 1983. S. 821 provided 1984 authorization levels of an estimated $124.1 million for NBS and other programs. Because this authorization level was lower than that authorized in H.R. 2513, estimated outlays were lower as well.

9. Estimate prepared by: Mary B. Maginniss (226-2860)

10. Estimate approved by:

JAMES L. BLUM,
Assistant Director for Budget Analysis.

11. COST AND BUDGET DATA

The bill would authorize appropriations for Fiscal Year 1984 in the amount of $130,112,000. In addition, $700,000 in excess foreign currency is authorized for 1984 for the expenses of NBS incurred outside the United States.

In accordance with the requirements of section 252(b) of the Legislative Reorganization Act of 1970, the Committee's estimate for the National Bureau of Standards and related agencies for the next five years is as follows:

Fiscal year:	
1984	$134,300,000
1985	140,800,000
1986	147,400,000
1987	154,200,000
1988	161,800,000

12. EFFECT OF LEGISLATION ON INFLATION

The anticipated inflationary impact of this legislation has been assessed in accordance with Rule XI, Clause 2(1)(4) of the Rules of the House of Representatives. No inflationary effect on prices and costs in the national economy is expected.

Expenditures by the National Bureau of Standards are, with few exceptions, for basic and applied measurements and standards related research within the Bureau's laboratories.

These enhanced R. & D. capabilities will encourage expansion of existing links between the Bureau's scientists and laboratories and industry. This will provide for more effective transfer of innovative research findings into the industrial sector. In this manner both national industrial productivity and competitiveness will be improved.

A number of economic studies have directly and indirectly indicated that the contribution of basic and applied research and development and innovation to economic growth, increased productivity, and favorable international trade balances is high. Increased productivity and comparative advantages in international trade are generally regarded as very effective measures in combatting inflation.

While there is a time lag and a degree of uncertainty in the innovation process from the conceptualization of an idea in a research setting to the commercialization of a new product or process, the importance of R. & D. in the innovation process and its ultimate impact upon industrial productivity cannot be denied. This has been a major premise in the establishment and continued funding of the Bureau.

13. COMMITTEE RECOMMENDATION

A quorum being present, the bill was ordered reported on April 19, 1983 by the Committee by a unanimous voice vote.

14. ADMINISTRATION VIEWS

The following letter from the Secretary of Commerce accompanied a draft legislative proposal recommended by the Administration. This was introduced by Mr. Fuqua on March 9, 1983, by request, as H.R. 1996.

THE SECRETARY OF COMMERCE,
Washington, D.C., February 10, 1983.

Hon. THOMAS P. O'NEILL, Jr.,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: Enclosed for consideration by the House of Representatives are six copies of a draft bill: "To authorize appropriations to the Secretary of Commerce for the programs of the National Bureau of Standards for fiscal years 1984 and 1985, and for other purposes," together with a supporting statement of purpose and need.

We have been advised by the Office of Management and Budget that there is no objection to the submission of this legislation to the Congress and that its enactment would be in accord with the program of the President.

Sincerely,

MALCOLM BALDRIGE,
Secretary of Commerce.

Enclosures.

A Bill To authorize appropriations to the Secretary of Commerce for the programs of the National Bureau of Standards for fiscal years 1984 and 1985, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Bureau of Standards Authorization Act for Fiscal Years 1984 and 1985."

AUTHORIZATION FOR PROGRAM ACTIVITIES

SEC. 2. There are authorized to be appropriated to the Secretary of Commerce to carry out activities performed by the National Bureau of Standards the sums set forth in the following line items:

(a) Measurement Research and Standards, $48,709,000 for fiscal year 1984 and such sums may be necessary for fiscal year 1985;

(b) Engineering Measurements and standards, $18,507,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985;

(c) Computer Sciences and Technology, $3,000,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985;

(d) Core Measurement Research for New Technologies, $12,407,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985;

(e) Technical competence Fund, $7,672,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985; and

(f) Central Technical Support, $8,405,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985.

EXCESS FOREIGN CURRENCY

SEC. 3. In addition to the sums authorized to be appropriated by section 2 of this Act, there are authorized to be appropriated to the Secretary of Commerce $700,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985 for expenses of the National Bureau of Standards incurred outside the United States, to be paid for in foreign currencies that the Secretary of the Treasury determines to be excess to the normal requirements of the United States.

OFFICE OF PRODUCTIVITY, TECHNOLOGY AND INNOVATION

SEC. 4. In addition to the sums authorized to be appropriated by sections 2 and 3 of this Act, there are authorized to be appropriated to the Secretary of Commerce $3,752,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985 for the activities of the Office of Productivity, Technology and Innovation.

SALARY ADJUSTMENTS

SEC. 5. In addition to the sums authorized to be appropriated by sections 2, 3, and 4 of this Act, there are authorized to be appropriated to the Secretary of Commerce for fiscal years 1984 and 1985 such additional sums as may be necessary to make any adjustments in salary, pay, retirement, and other employee benefits which may be provided for by law.

AVAILABILITY OF APPROPRIATIONS

SEC. 6. Appropriations made under the authority provided in this Act shall remain available for obligation, for expenditure, or for obligation and expenditure for such period or periods, as may be specified in the Acts making such appropriations.

COST RECOVERY AUTHORITY

SEC. 7. Section 12(f) of the Act of March 3, 1901, as amended (15 U.S.C. 278b(f)), is further amended by deleting the word "first" and by inserting the following words immediately before the period at the end thereof: ", and to ensure the availability of working capital necessary to replace equipment and inventories."

STATEMENT OF PURPOSE AND NEED

The National Bureau of Standards (NBS), the Nation's oldest national laboratory and lead agency for measurement science and standards, was created by the Act of March 3, 1901 (Pub. L. No. 56-177; 15 U.S.C. 271-278h) (hereinafter cited as the "Organic Act" or "Act"). Pursuant to that Act, the Secretary of Commerce (hereinafter "Secretary") is authorized to undertake a variety of functions including: the custody, maintenance, and development of the Nation's standards of physical measurement and provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods for testing materials, mechanisms, structures, supplies and equipment; cooperation with other Federal agencies and the private sector in the establishment of standard practices; the provision of advisory services to government agencies on scientific and technical problems; and the invention and development of devices to serve special national needs.

Public Law No. 97-286, dated October 6, 1982, authorizes appropriations to the Secretary of Commerce for fiscal year 1983 for all of NBS' activities and operations, including those performed under the Organic Act and under other statutes such as the Standard Reference Data Act (15 U.S.C. 290-290f). Public Law No. 97-286 also authorizes appropriations for fiscal year 1983 for research, development and related activities in the fields of innovation and productivity under the auspices of the Assistant Secretary of Commerce for Productivity, Technology and Innovation. The primary purpose of this bill is to authorize appropriations to the Secretary of Commerce for fiscal years 1984 and 1985 for the activities of NBS and of the Office of Productivity, Technology and Innovation.

Section 1 provides that this bill may be cited as the National Bureau of Standards Authorization Act of Fiscal Years 1984 and 1985.

Section 2 authorizes appropriations to the Secretary of Commerce to carry out the following line item activities of the National Bureau of Standards: $48,709,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985 for Measurement Research and Standards; $18,507,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985 for Engineering Measurements and Standards; $3,000,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985 for Computer Sciences and Technology; $12,407,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985 for Core Measurement Research for New Technologies; $7,672,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985 for the Technical Competence Fund; and $8,405,000 for fiscal year 1984 and such sums as may be necessary for fiscal year 1985 for Central Technical support. These items include NBS' Organic Act activities and NBS' activities under other statutes, such as the Standard Reference Data Act.

Section 3 authorizes, in addition to those sums authorized in section 2, appropriations to the Secretary of Commerce of $700,000 for fiscal year 1984 and of such sums as may be necessary for fiscal year 1985 to be paid in foreign currencies owned by the United States for expenses incurred by NBS outside the United States and which the Secretary of the Treasury determines to be excess to the normal requirements of the United States.

Section 4 authorizes appropriations of $3,752,000 to the Secretary of Commerce for fiscal year 1984 and such sums as may be necessary for fiscal year 1985 to carry out the activities of the Office of Productivity, Technology and Innovation. These activities are designed to promote technological innovation and productivity and advance the competitive capability of the nation's products and services in the world market. Activities include policy studies and recommendations aimed at finding better ways to stimulate private sector productivity improvement and private sector commercialization of technological innovation; dissemination of productivity-related information through operation of a productivity reference center; dissemination of technological information developed by the Federal Government through operation of a Center for the utilization of Federal Technology; facilitation and promotion of the use of research and development limited partnerships; coordination of Federal patent policy; licensing of Federally owned patents for commercial development; and promotion of voluntary conversion to the metric system.

Section 5 authorizes the appropriations of such additional sums as may be necessary to make any adjustments in salary, pay, retirement, and other employee benefits which may be provided for by law.

Section 6 provides that appropriations made under the authority provided in this Act shall remain available for obligation, for expenditure, or for obligation and expenditure for the periods specified in the Acts making such appropriations. The final determination to limit the availability of an appropriation to a single year or for multiple-years is made when an appropriation bill is enacted by the Congress. An appropriation bill providing for other than single-year availability would be subject to a point of order if an authorizing statute had not previously been enacted. Section 6 of this bill provides this necessary authority. In addition most research and development organizations are subject to uncertainties inherent in research programs, to a high incidence of unpredictable factors that compel the readjustment of program activities, and to the need for flexibility to permit prompt response to changed circumstances. Section 6 also provides for this necessary flexibility for the scientific and engineering research programs of NBS.

Section 7 amends section 12(f) of the Organic Act to allow net income to be used to replace equipment and inventories before the net sales proceeds are paid into the general fund of the Treasury. At present NBS equipment and inventories are purchased through the Working Capital Fund (WCF), an accounting entity established by the Deficiency Appropriations Act, 1950 (Pub. L. No. 81-583), to provide NBS with capability for effective fiscal management. All NBS operating expenses are paid from the WCF, and the WCF is then reimbursed from funds appropriated to NBS or from funds paid to NBS by the private sector or other government agencies in return for NBS services or inventories.

Under existing authority the WCF may recover only its original investment in equipment and inventories and not the actual replacement cost. It is reimbursed for its investment in equipment through pro rata charges for depreciation over the useful life of the equipment, and recovers its investment in inventories as items are sold from stock. However, in these times of continually rising prices, current replacement cost often far exceed the original investments. Then, since the recovered amounts are insufficient for replacement of new equipment and inventories at current prices, NBS must, in order to maintain its equipment and inventory levels, periodically request additional appropriations for restoration of the WCF. In the case of standard reference materials (SRM), the need for additional appropriations to cover replacement costs could be avoided by raising the SRM sales fees charged. However, at present NBS lacks the authority needed to retain the proceeds from such fee increases. Section 7 of this Act provides that authority. If granted, it is estimated this new authority could within five years result in savings in appropriations in excess of $2 million.

15. CHANGES IN EXISTING LAW MADE BY THE BILL AS REPORTED

In compliance with clause 3 of Rule XIII of the Rules of the House of Representatives, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new matter is printed in italics, existing law in which no change is proposed is shown in roman):

SECTION 12 OF THE ACT OF MARCH 3, 1901

An Act To establish the National Bureau of Standards.

* * * * * * *

SEC. 12. (a) The National Bureau of Standards is authorized to utilize in the performance of its functions the Working Capital Fund established by the Act of June 29, 1950 (64 Stat. 275).

(b) The working capital of the fund shall be available for obligation and payment for any activities authorized by this Act, as amended, and for any activities for which provision is made in the appropriations which reimburse the fund.

(c) In the performance of authorized activities, the Working Capital Fund shall be available and may be reimbursed for expenses of hire of automobile, hire of consultants, and travel to meetings, to the extent that such expenses are authorized for the appropriations of the Department of Commerce.

(d) The fund may be credited with advances and reimbursements, including receipts from non-Federal sources, for services performed under the authority of section 3 of this Act.

(e) As used in this Act the term "cost" shall be construed to include directly related expenses and appropriate charges for indirect and administrative expenses.

(f) The amount of any earned net income resulting from the operation of the fund at the close of each fiscal year shall be paid into the general fund of the Treasury: *Provided,* That such earned net income may be applied [first] to restore any prior impairment of the fund, *and to ensure the availability of working capital necessary to replace equipment and inventories.*

16. MINORITY VIEWS

National Bureau of Standards Fiscal Year 1984 Authorization, H.R. 2513

The members on the Committee on Science and Technology were faced with serious decisions regarding the proposed fiscal year 1984 budgetary cuts in several substantive programs at the National Bureau of Standards. The Minority shares many of the same concerns as the majority and we support the activities of the Center for Fire Research, Building Research Center, and Institute Computer Science and Technology Program. Hence we concur with the Committee's decision to restore funds to these programs.

In addition, the Minority supports restoration of $500,000 to the Automated Manufacturing Research program for robotics work. Research in this field has been strongly supported by the members of this Committee. While larger, more sophisticated companies can perform some of this work, small-batch manufacturers often lack the technical capabilities and resources to solve interface standards and mechanical engineering metrology. In an age of technological advances, this work makes a significant contribution to the adaptation taking place in the work force.

The Minority offered a substitute to the Committee bill which restored total NBS funding to the fiscal year 1983 appropriated level of $117.7 million. This represented a 19-percent increase above the request and preserved the programs described above. In addition, the Minority restored funds to selected programs proposed for substantial user-fee increases (Measurement Assurance Program and Nonmetallic Materials). While we believe increased fees are an appropriate step in offsetting production costs, the Minority advocates an incremental approach. The Minority cannot support the level of funding imposed by the Majority. It represents a 26-percent increase over the requested level of $98.7 million, adds monies for new initiatives, and disregards any impetus to offset reasonable costs incurred by the production of Standard Reference Materials. We believe it does not represent the most sound, fiscally responsible, recommendation this Committee can produce.

LARRY WINN, Jr.
MANUEL LUJAN, Jr.
ROBERT S. WALKER.
WILLIAM CARNEY.
F. JAMES SENSENBRENNER, Jr.
JUDD GREGG.
RAYMOND J. MCGRATH.
JOE SKEEN.
CLAUDINE SCHNEIDER.
BILL LOWERY.
ROD CHANDLER.
HERBERT H. BATEMAN.
AL MCCANDLESS.
TOM LEWIS.

17. ADDITIONAL VIEWS OF HON. SHERWOOD BOEHLERT

H.R. 2513

I would like to concur with the views of the Minority Members on the Committee on Science and Technology with regard to the fiscal year 1984 fiscal authorization recommendations. The exception which I must make, however, is to support the proposed committee funding level for the Robotics program at the National Bureau of Standards. H.R. 2513 would provide a floor of $3.5 million for research and generic technology development in the field of robotics. This is $300,000 above the fiscal year 1983 appropriated level.

Our nation's workplace is undergoing changes in education, training, and retraining requirements with the increasing adaptation to automation and advanced technologies. I am looking to make the United States number one in this important field. A continued federal effort is necessary to insure proper interface between technology and industry. The Bureau has demonstrated excellence in this area and should continue to play that role.

SHERWOOD BOEHLERT.

○